Information by: Craig Frear **Ammonia Stripping with Ammonium Sulfate Recovery**

Company Information	
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Initial Technology Overview – This information is to guide in the development of a more specific and detailed Technology Information Request

Technology Available	Please answer the following questions for each Technology or Service Provided
1. What is the name of the technology or service you provide?	**Ammonia Stripping with Ammonium Sulfate Recovery**
2. Describe how this technology is used in a larger Nutrient Management System. Please be as detailed as possible.	After anaerobic digestion, fiber separation and DAF fine solids removal is a liquid effluent with very little suspended solids, high concentration of ammonia, relatively high pH and decent remaining temperature with waste heat. This allows for non-chemical air stripping at elevated temperatures to yield free ammonia which is contacted with acid to make ammonia sulfate
3. How many systems do you have installed on dairy farms or other livestock operations?	Number of Sites / Size of Installations Dairy: 4 / 750-2,000 cows Pork: / Poultry: 1 / 1 million layers
4. Do you have a preferred region or area for the location of projects?	The technology is most marketable as a necessary component with poultry or mixed poultry AD, as the ammonia is higher in concentration and due to ammonia toxicity and solids dilution, effluent recycle with ammonia removed is required. Dairy/swine would be a second option
5. Location of farm(s)	Anywhere, projects with higher ammonia concentrations and need for return/dilution water ideal, larger size operations gives better economy of scale
6. What's the smallest and largest farm using your system?	750 cows plus co-digestion as a low to a high with the 1 million layers, although there is not a technical size limitation, one only of economics and project need.
7. Input and output of your unit/system – do you have a mass balance analysis? If a mass balance is available, please attach or include as a separate document.	Inputs: Post-DAF liquid, waste heat, ambient air/blower, concentrated sulfuric acid for recovery Outputs: Ammonium sulfate (either as solution or as crystal), low-N liquid wastewater Mass Balance: 0.05 MT/cow/year TAN at 70% removal, yields 0.015 MT/cow/year TAN in wastewater, 0.035 MT/cow/year stripped TAN, 0.136 MT/cow/year ammonium sulfate (dry at 21:0:0:24) or 0.358 MT/cow/year ammonium sulfate (solution at 8:0:0:9) while using 0.109 MT/cow/year in 93% concentrated sulfuric acid—assuming scrape dairy manure post-DAF with no substrates and a starting concentration of TAN around 1,500 ppm.
8. Input material description/characteristics (raw manure, digestate, screened	Input is assumed to be post-DAF effluent from a digester. System can work pre-DAF but is less efficient due to presence of suspended solids

digestate, suitable non-farm feedstocks, other)	
9. Does the technology treat the full manure stream for a farm or a fraction of the stream?	The system is designed to treat the entire post-DAF effluent volume.
10. Do you consider this a mature system or ongoing farm development?	This is mature, multiple sites—although on-going R/D continues to develop an improved business plan—less air/electricity input, greater mass transfer, better heat utilization, greater TAN removal rate and improved product markets
11. Any weather constraints?	No although, we have limited available waste heat on projects, so colder the manure, the less waste heat to raise temperature and strip ammonia. Thus, greater performance at warmer.
12. Any bedding constraints?	No, but with all digesters, no sand and digested fiber bedding preferred and if sand, up front sand processing steps will be required
13. Output materials description and characteristics (please include the % of the total stream for each material) i.e. 10% fiber and 90% screened liquid by weight.	Available in earlier mass balance (#7). In summary though, 100% post-DAF effluent volume in, yields same effluent volume out minus about 10% of volume due to evaporation during process. We aim for 70% ammonia removal but do not always achieve that due to temperature, energy constraints.
14. Do the Outputs of the process have a resale market identified? If so under what brand name or who is the contract with?	The output of the process is the ammonium sulfate solution (crystals if additional drying system installed, extra capital/OM cost). If solution, main market appears to be as blending material to nearby coop fertilizer products. If crystal, longer distance market, sold not just as blending product but as final product—20% discount to fossil ammonium sulfate as crystals are fines so not as nice of product. Not refined usually for non-AG markets although they do exist.
15. Is this process scalable and to what extent (top and bottom limits)?	The process is scalable and only impacted by economics and project needs
16. Do you have a known scaling factor?	At present, the scaling cost factor is not exact and use a tentative linear scale costing
17. Does this technology require any air input?	This system requires the input of air via blowers to induce the stripping process

18. What is the preferred air connection? (psi, fitting size, air quality) If not distributed by the system please list each connected device.	The preferred system uses ambient air that is heated and put under pressure to suitably operate the blowers and supply the necessary air for the process.
19. Does this technology require any water input?	We install water connections to operate necessary OSHA safety washers as well as periodic cleaning of acid tower
20. What is the preferred water connection? (psi, fitting size, water quality, gpm) If not distributed by the system please list each connected device.	Normal fittings, just meet OSHA requirements, while periodic acid tower wash can be simple hose connection
21. Does this technology require any electrical input?	Yes, the electrical input is to operate the blowers, pumps, valves, etc. There is electrical parasitic load to this system
22. What is the preferred electrical connection? (Phase #, Voltage, Full Load Amps) If not distributed by the system please list each connected device.	Three phase
23. Does this technology require any mechanical input?	Mechanical systems are utilized throughout
24. What is the preferred mechanical connection? (Horsepower, connection, rpms) If not distributed by the system please list each connected device.	Per specifications of purchased mechanical equipment
25. Does this technology require any special plumbing? (Please describe what is required)	Plumbing, wiring, etc. is all engineered by DVO and completed by general contractor

26. Does this system require and special foundations or pads? (please describe)	Yes, aeration pit and acid tower/AS processing require special foundations and pads to meet required engineering and use of acids.
27. Do you consider this technology part of a larger system that you provide?	Yes, DVO supplies a full-system starting with anaerobic digestion and through fiber separation, fine solids separation, and liquid ammonia treatment through various platforms, with ammonia stripping being one of those ammonia treatment platforms. The ammonia stripping system also can integrate a hydrogen sulfide scrubbing unit quite nicely
28. Does your system require any other components that you do not provide or are not included in your proposal?	Storage is required for the sulfuric acid as well as the produced ammonium sulfate, intake/outtake stations needed for incoming/outgoing products, OSHA safety equipment, sound insulation for blowers
29. How is the system delivered to the site? (Skid Mounted, Assembled on Site, Constructed on Site, etc.….)	Assembled on site with construction on site as well.
30. Is this system portable or configured in such a way that it could be easily transported for use in several locations?	Not easily moved.
31. Has your technology has been accepted by the NRCS and is it included into a practice standard?	It is not a NRCS practice standard
32. Are the any unusable or hazardous byproducts of this process? If so please describe the product and recommended means of disposal.	There is an emission from the acid tower that is hot carbon dioxide and water vapor.
33. What spare parts and redundant components are included with the system?	DVO would supply operational manual as well as training and O/M servicing/parts replacement plan.

34. How is the system controlled and what are the components and capabilities of the control system?	The system is placed on electronic operational control for 24/7 automated operation. A daily walk through and check list is required to maintain effective operation.
35. What is the usable life of the system?	Main components have limited life expectancy such as diffusers (4-5 years) but continued planned O/M should allow for a 20-30 year expectancy.
36. What is the salvage value at the end of the usable life?	Key components such as blowers, valves, meters, diffusers have salvage value.
37. What is the educational and technical level of competence for the operation of the system?	Labor trained for operation of digester, digester systems, fiber screens and DAF systems should be able to operate this additional system as well. Training and hard/working, reliable labor required.
38. What level of maintenance is required for the system? (Please indicate if rebuilds or major components must be replaced and what the frequency is for these components)	See above, component parts will be on replacement schedule, daily walk through as well as periodic response to system upsets required.
39. Are consumables used in the process? Please provide the nature and purchase relationship for these consumables. (Proprietary, special contract, generally available)	The main consumable is the sulfuric acid but also miscellaneous parts.
40. Which of these NRCS codes would your technology be classified under (check all that apply)? Add If necessary.	

CODE	NRCS Description	Applies (X)
472	Access Control	
560	Access Road	
309	Agrichemical Handling	X
371	Air Filtration and Scrubbing	X
591	Amendments for the Treatment of Agricultural Waste	
366	Anaerobic Digester	

	672	Building Envelope Improvement	
	372	Combustion System Improvement	
	317	Composting Facility	
	554	Drainage Water Management	
	375	Dust Control from Animal Activity on Open Lot Surfaces	
	373	Dust Control on Unpaved Roads and Surfaces	
	374	Farmstead Energy Improvement	
	512	Forage and Biomass Planting	
	561	Heavy Use Area Protection	
	516	Livestock Pipeline	
	590	Nutrient Management	X
	521A	Pond Sealing or Lining, Flexible Membrane	
	533	Pumping Plant	
	558	Roof Runoff Structure	
	367	Roofs and Covers	
	318	Short-Term Storage of Animal Waste and By-Products	
	570	Stormwater Runoff Control	
	606	Subsurface Drain	
	635	Vegetated Treatment Area	
	601	Vegetative Barrier	
	360	Waste Facility Closure	
	632	Waste Separation Facility	
	313	Waste Storage Facility	
	634	Waste Transfer	
	629	Waste Treatment	
	359	Waste Treatment Lagoon	
41. Can you provide an estimate of the capital required for the installation of this technology? Please include all	Can provide capital and O/M estimates on a project to project basis.		

components and designate if provided by you or others.	
42. Can you provide an estimate of the operational costs required for this technology? Please include all costs and designate if provided by you or others.	Project by project estimate available on request
43. Is there financing available for this system? If so what are the conditions for this financing?	No
44. Is the system available for lease?	No
45. What sort of warrantee or guarantee do you provide with this technology? Do you provide any performance guarantees or strictly defects in parts and materials?	Warranty discussions on a project by project basis
46. Explain how this system is unique or transformative and how does it improve upon or go beyond other technologies that are currently available.	There are multiple ammonia stripping technologies available, although for on-farm use the options are vastly reduced. The DVO system is unique in its non-tower approach which is more conducive to wastewater streams with suspended solids and is also unique in that it strips the ammonia with no chemical/pH inputs other than the air—this distinguishes DVO from other carbon dioxide strippers that also require lime or other chemical inputs.
47. Would you be willing to provide a location for a site visit by Newtrient?	Yes, we will gladly supply a location and tour for site visit.
48. Technology References – customers with whom we can discuss this technology and its performance (please include a company name, location, contact name and contact information)	Reference 1: Reference 2: Reference 3:

49. Are there any other facts about this technology that you feel should be included in this document?	We believe we have covered it all, but if additional questions are developed or additional information is required please do not hesitate to ask.