
N2 Applied
Manure Enricher
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PRO-DAIRY | Dairy Environmental Systems Program
Cornell University, Department of Animal Science
www.cals.cornell.edu/PRO-DAIRY/DES
Livestock and Poultry Environmental Learning Community
March 21st, 2025
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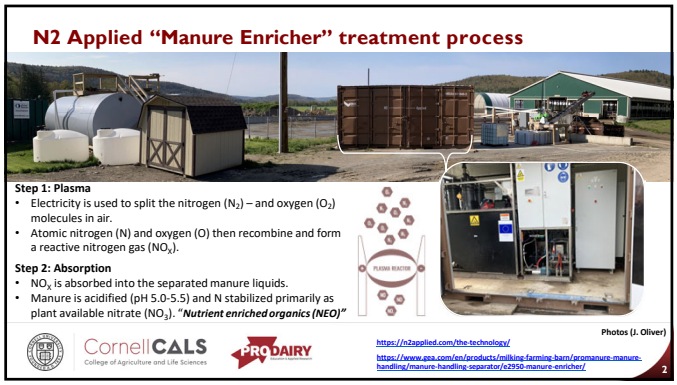
NEWTRIENT

1


N2 Applied "Manure Enricher" treatment process
Step 1: Plasma
• Electricity is used to split the nitrogen (N_2) – and oxygen (O_2) molecules in air.
• Atomic nitrogen (N) and oxygen (O) then recombine and form a reactive nitrogen gas (NO_x).
Step 2: Absorption
• NO_x is absorbed into the separated manure liquids.
• Manure is acidified (pH 5.0-5.5) and N stabilized primarily as plant available nitrate (NO_3). "Nutrient enriched organics (NEO)"
Photos (J. Oliver)
https://n2applied.com/the-technology/
https://www.gea.com/en/products/milking-farming-barn/promanure-manure-handling/manure-handling-separator/e2950-manure-enricher/
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2


Farm interest in hosting N2 trial
• Achieve farm sustainability goals
• Support collaborative efforts to meet industry goals
• On-farm methane emission reductions
• Plant available N on-hand
• Closed loop system for recycling on-farm resources
• No odor
• Technology performs as intended
CoBar Dairy, LLC
Mount Upton, NY
CABOT CREAMERY
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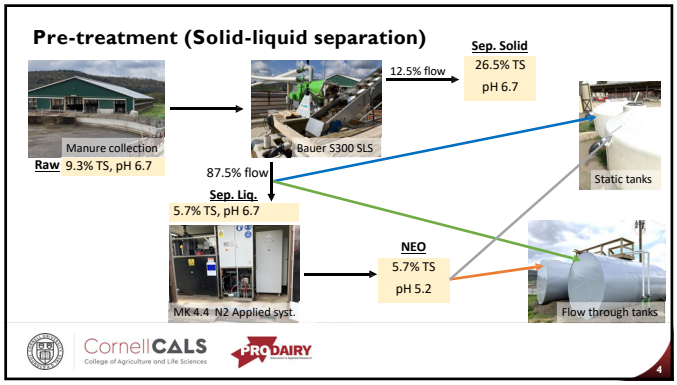
3


Pre-treatment (Solid-liquid separation)
Manure collection
Raw 9.3% TS, pH 6.7
Bauer S300 SLS
12.5% flow
Sep. Solid
26.5% TS
pH 6.7
Static tanks
87.5% flow
Sep. Liq.
5.7% TS, pH 6.7
MK 4.4 N2 Applied syst.
NEO
5.7% TS
pH 5.2
Flow through tanks
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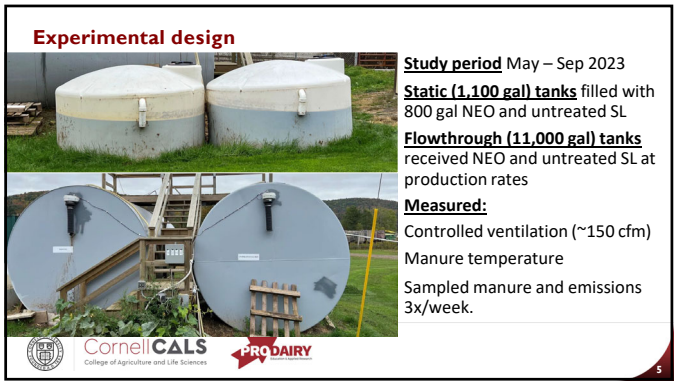
4


Experimental design
Study period May – Sep 2023
Static (1,100 gal) tanks filled with 800 gal NEO and untreated SL
Flowthrough (11,000 gal) tanks received NEO and untreated SL at production rates
Measured:
Controlled ventilation (~150 cfm)
Manure temperature
Sampled manure and emissions 3x/week.
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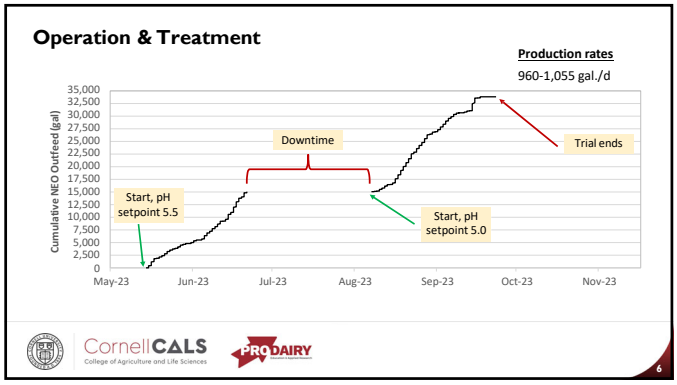
5


Operation & Treatment
Production rates
960-1,055 gal./d
Cumulative NEO Outfeed (gal)
35,000
32,500
30,000
27,500
25,000
22,500
20,000
17,500
15,000
12,500
10,000
7,500
5,000
2,500
0
May-23
Jun-23
Jul-23
Aug-23
Sep-23
Oct-23
Nov-23
Downtime
Trial ends
Start, pH setpoint 5.5
Start, pH setpoint 5.0
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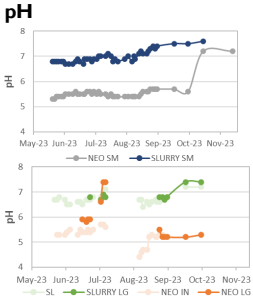
6

pH



Static tanks
Untreated: avg. 6.7
NEO: avg. 5.4

Flow through tanks
Untreated: avg. 6.9
NEO: (Phase I) avg. 5.9
(Phase II) avg. 5.3

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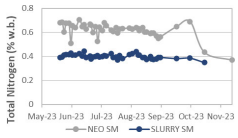
7

7

Manure N



Static tanks
Untreated: avg 0.39
NEO: avg 0.62
↑57%

Untreated:
NH_4-N 17.5 lbs/1,000 gal
Org N 15.2
NO_3-N 0.1
TN 32.7

NEO:
NH_4-N 15.0
Org N 20.9
NO_3-N 21.3
TKN 57.2

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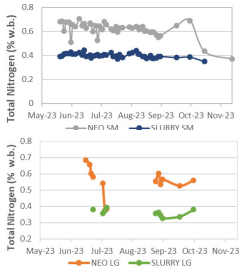
8

8

Manure N



Static tanks
Untreated: avg 0.39
NEO: avg 0.62
↑57%

Flow through tanks
Untreated: avg. 0.36
NEO: (Phase I) avg. 0.55
(Phase II) avg. 0.55
↑53%

**P & K values unchanged

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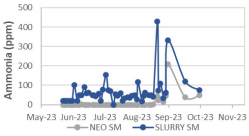
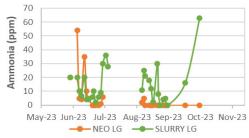
9

9

Ammonia





Static tanks

Untreated: 0-430 ppm, avg 67 ppm ↓85%

NEO: 0-2 ppm (until 8/18), avg 10 ppm

Flow through tanks

Untreated: 4-63 ppm, avg. 14 ppm

NEO: (Phase I) 0-54 ppm, avg. 11 ppm

(Phase II) 0-5 ppm, avg. 0.5 ppm

↓21-96%

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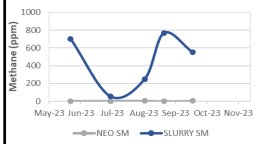
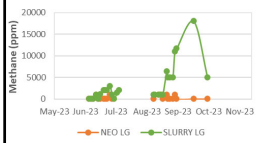
10

10

Methane





Static tanks

Untreated: 54-768 ppm

NEO: 0-3 ppm

↓99%

Flow through tanks

Untreated:

(Phase I) 0-3,000, avg. 1,114 ppm

(Phase II) 1,000-18,000 ppm, avg. 5,546 ppm

NEO:

(Phase I) 0-1,000 ppm, avg. 117 ppm

(Phase II) 0-1,000 ppm, avg. 384 ppm

↓91%

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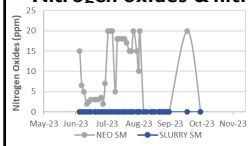
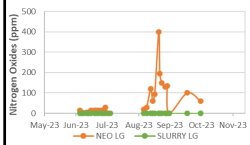
11

11

Nitrogen oxides & nitrous oxide





Static tanks

Untreated: 0 ppm

NEO: 2-20 ppm

Flow through tanks

Untreated: 0 ppm

NEO: (Phase I) 0-30 ppm, avg. 11 ppm

(Phase II) 0-400 ppm, avg. 115 ppm

Nitrous oxide (N_2O)

Limited data, substantial increase

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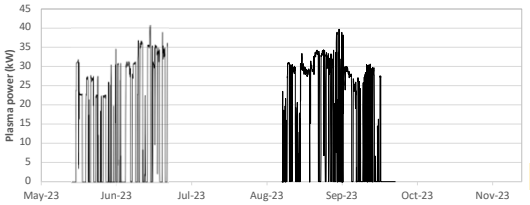
12

12

Energy & economics

- N2 (model MK 4.4) 50kW machine, peaked 55.6-62.8 kW…plasma torch was most energy
- Power demand: avg. 24.2kW, estimated at 260,000 kWh / yr



$0.13/gal

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13

13

Lessons Learned

- NEO remains enriched in nitrogen with reduced emissions of NH_3 and CH_4 for at least several months during the summer, but longer-term stability of NEO, particularly during colder months was not evaluated.
- Need to study a commercial Gen 0 unit under continuous operation to accurately assess treatment effects, production rates, capital, and operating cost breakdowns.
- Both the N2 Applied unit and the storage of NEO are potential sources of NO_x and N_2O emissions.
- Need for agronomic trials of NEO in concert with field emissions monitoring to ensure NEO can improve crop yield and quality while not contributing to elevated emissions of NH_3, N_2O, or other emissions.

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14

14

PRO-DAIRY Education & Applied Research

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NY farm viability INSTITUTE

Research Report and Data:
https://www.newtrient.com/catalog/n2-applied-plasma-reactor/

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15

15