APPLICATION FOR COMPONENT ADDITION TO NRCS

NRCS Practice Standard 317 (Evaluation Followed Practice Standard 629 Protocol)

For Acceptance of Drum Composting

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APPLICATION FOR COMPONENT ADDITION TO NRCS Practice Standard 317 (Evaluation Followed Practice Standard 629 Protocol):

Drum Composting

REQUEST

Natural Resources Conservation Service (NRCS) Conservation Practice Standard Composting Facility (Code 317) "…is a standard for a facility that will accommodate and facilitate a desired composting process."

NRCS Practice Standard 629 Waste Treatment (CPS 629) is a broad standard for waste treatment which establishes a standard format for presenting the information related to evaluating manure treatment technologies. Newtrient has developed a testing and reporting protocol for manure treatment technologies based on CPS 629 that was used to evaluate drum composting at Fessenden Dairy in King Ferry, NY. This application is for inclusion as a supplement to code 317 under "*Drum Composting.*"

BRIEF DESCRIPTION OF COMPONENT CLASS

Drum composting is an intensive aerobic composting process that utilizes a rotating drum to continuously move and tumble the mixture in the drum to increase air circulation and achieve uniform heating.

To remove the humidity in the system, ambient air is drawn through the material during turning as the air is continuously sucked out of the drum. The temperature is maintained between 65-70°C and the process takes about 1-3 days to complete. The treatment provides a homogenous finished product that can be used as bedding and is generally free of most pathogens.

DETAILED DESCRIPTION

While specific technical approaches within the larger class have notable distinction, the technology is applied in the following systems approach, which also separates out the solids via a specially designed screw press separator, as shown in **Figure 1**.

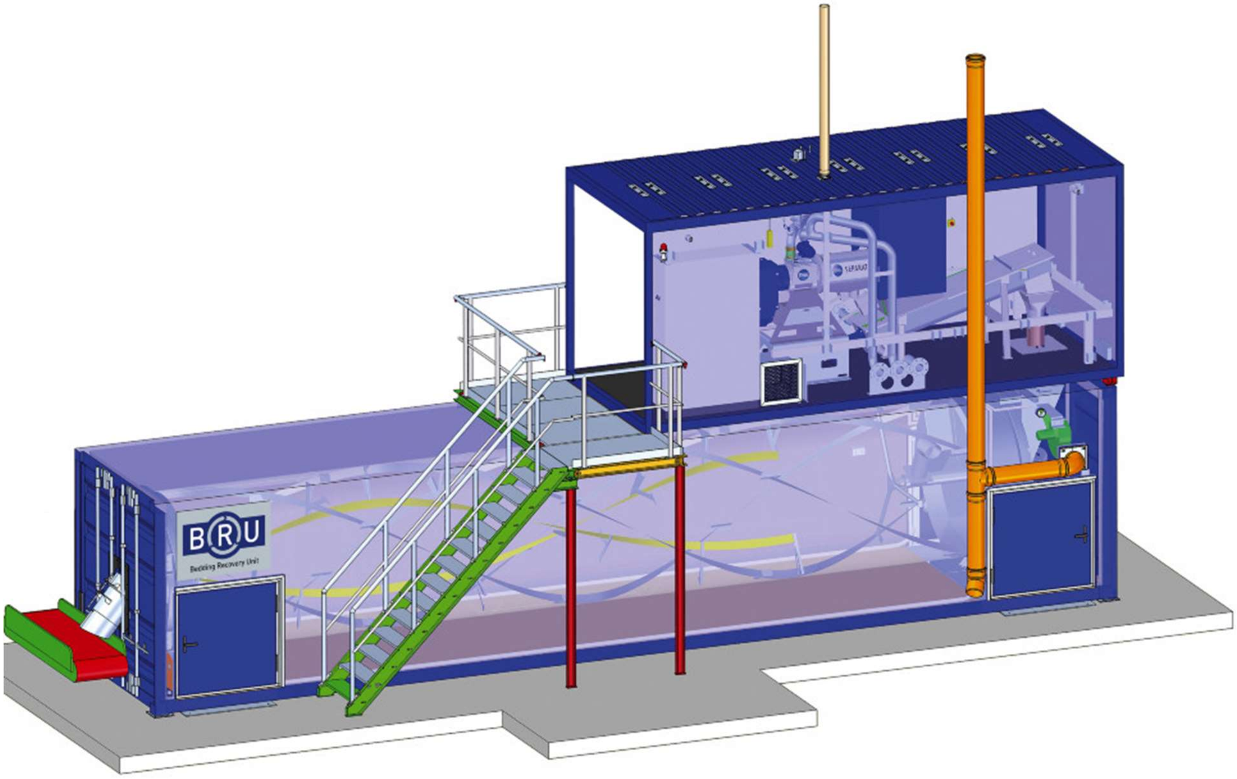


Figure 1. FAN Bedding Recovery Unit (BRU) Process Flow Diagram.

Drum composting generally takes place by integrating two technologies, solids separation followed by drum composting, to improve operational efficiency. In step one, solid-liquid separation is performed as a pre-treatment to rotary drum composting. Rotary drum composters are typically integrated with a solids separator that separates recycled manure solids and fiber from raw slurry. Units are sized for dairies with hundreds to thousands of cows that harvest manure as raw slurry with typical solids content of around 10%. Recycled manure solids (RMS) are captured after raw slurry goes through a screw press, slope or vibrating screen separator with rollers and typically comes out at around 30-35% dry matter. The RMS then drop onto a conveyor belt that feeds into a rotary drum composter.

In step two, the solids are dried in a composting drum for 1-3 days, operating at approximately 70°C. The drum uses continuous mixing and aeration to reduce humidity, odor, and pathogens, and provides optimal homogenization of the material.

In the most basic terms, a drum compost system includes the following four components:

- a *separator*, either a screw press, slope, or vibrating screen separator with rollers
- a *belt conveyor or auger* that feeds the RMS into the rotary drum composter
- a *rotating drum* that accelerates the drying process and leads to a modest reduction in moisture and a significant reduction in pathogens
- a *ventilator* or *fan* to regulate the aerobic process
- a *control system* that measures the temperature and controls the air flow through the system

HOW PROPOSED SYSTEM ACCOMPLISHES PURPOSES OF THE STANDARD

Tight margins for dairies mean it is critical for dairy producers to focus on efficiency to remain profitable. A significant increase in the cost of traditional bedding sources has driven an increase in the use of RMS as an alternative bedding source on dairies.

Recycled manure solids are obtained by mechanical separation of the manure from the housing barn. Proper bedding keeps cows dry and clean and prevents injuries and illness, particularly mastitis. RMS are known to favor the growth of bacteria but with their low cost of recovery and high on-site availability, they have become a common source of bedding.

To create a safer bedding from RMS through pathogen kill and material drying, innovative composting technologies such as drum composting continue to emerge, with the added benefit of keeping operational costs low and minimizing the farms environmental footprint. To help dairy farmers manage risk and make an informed decision before adopting this or any class of technology, a third-party evaluation is necessary.

Newtrient (www.newtrient.com), a dairy industry-sponsored company focused on value-added and environmentally beneficial management of manure, has recently completed a review of technology classes within manure management and their impact on key critical environmental indicators. One such review, complete with quantitative analysis, summary discussion, and peer-reviewed literature citation is for Drum Composting and is attached in Appendix A of this application. In summation and building upon that Appendix is the following brief discussion of key water, air, and other environmental indicators that are impacted by this class of technology and applicable to the purposes of Standard 317. Appendix B uses data from one commercial installation to offer both a visual and nutrient profile to show the impact that inclusion of a Drum Compost system can have on an overall manure management system. Appendix C is the final report for the study conducted by Wells College on the commercial installation.

Reducing nutrient content, organic strength

Compost designated for use as bedding material typically possesses a moisture content ranging between 65% and 68%. Utilizing drum composting for bedding initiates the biodegradation of organic compounds; however, this process remains incomplete at the specified moisture content. Consequently, the resulting bedding material lacks stability, and if left accumulated for an extended period, it may undergo undesired heating. Additionally, there is a potential loss of nitrogen through processes such as volatilization. Notably, without further processing, the technology employed does not yield a Class I or II fully mature compost product, indicating limitations in terms of maturity, stability, and potential pathogen and weed seed content.

Composts are categorized into distinct classes based on their level of maturity and quality. The U.S. Environmental Protection Agency (EPA) has established guidelines for compost classes, and they are as follows:

> Class I compost represents the pinnacle of maturity and stability, adhering to stringent standards with low pathogenicity and minimal weed seed content.
>
> Class II compost, while also mature, may exhibit slightly higher levels of pathogens and weed seeds.

These classifications are pivotal for determining the suitability of compost for specific applications. Within the described technological framework, it is noteworthy that without additional processing, the resulting compost does not meet the standards of Class I or II, indicating limitations in its maturity, stability, and potentially, pathogen and weed seed content.

Reducing odor and gaseous emissions

Drum composting, as a controlled and enclosed composting method, has the potential to mitigate gaseous emissions compared to open-air composting systems. The enclosed design of the drum helps in better control of the composting environment, including temperature, moisture, and airflow. This controlled environment can lead to a more efficient breakdown of organic materials, reducing the likelihood of anaerobic conditions that produce odor and gaseous emissions. Additionally, rotating drum composting serves as an offset by preventing the decomposition of solids in basins or lagoons, resulting in a significant 66% reduction in overall greenhouse gas (GHG) emissions, particularly methane, linked to the composting process.

Facilitating desirable waste handling and storage

Drum composting systems provide a modest reduction in storage volume (10%) by taking the RMS from around 30 – 35% dry matter to around 40 – 45% dry matter.

Producing value added byproducts that facilitate manure and waste utilization

Producers commonly allocate approximately 60% of the RMS for bedding purposes, while the remaining 40% presents an opportunity for sale to other producers. This surplus material is often sought after for bedding or sold, with the nursery industry being a common buyer, where it is frequently blended with potting soil.

DESIRED FEEDSTOCK CHARACTERISTICS

Feedstocks are organic raw materials that serve as the basis for various processes. In drum composting, the feedstock encompasses a diverse range of waste materials, including but not limited to cattle manure, swine manure, chicken litter, municipal bio-solids, brewery sludge, animal mortalities, and food residuals.

EXPECTED SYSTEM PERFORMANCE

The biological process inside the drum is monitored and controlled with temperature metering and airflow rate. The material produced by the BRUs outlet has a dry matter content of 40 to 42%. The BRU-400 produces up to 10 cubic meters (13.1 cubic yards) of compost material per day, the BRU-1000 produces up to 24 cubic meters per day (31.4 cubic yards) and the BRU-2000 produces 48 cubic meters per day (62.8 cubic yards). While drum composting may demand more ardent monitoring, the advantages of achieving higher temperatures and maintaining consistent aeration are readily apparent in terms of time efficiency.

- *Changes in form or handling characteristics*
    - During the composting process, the release of carbon dioxide leads to a reduction in pile size, and the feedstock's particle size becomes lighter and

smaller. In the case of manure feedstock, both volume and density decrease by approximately 50-65%. The end result is a compost with a consistent appearance, typically dark brown or black, accompanied by an earthy smell and the absence of any ammonia odor.

- *Nutrient fate or end use projections*
    - The nutrients present in mature compost exhibit increased stability, often necessitating a gradual release over a period of three years or more. Feedstock that includes dairy manure carries essential nutrients like nitrogen, phosphorus, and potassium, along with various micronutrients and organic matter. Upon reaching maturity, the final compost pile generally contains 30-50% less carbon than its initial composition.
- *Macro-nutrient reductions or transformations*
    - Drum composting, operating within a controlled environment, significantly influences macro-nutrient reductions and transformations. The process involves precise management of factors such as temperature, moisture, and aeration, influencing the breakdown and transformation of macro-nutrients present in the compost feedstock. This controlled transformation is essential for optimizing nutrient content and creating a more balanced and stable compost for various agricultural or horticultural applications. However, it's important to note that the technology does experience nitrogen loss during the composting process, where ammonia gas is released into the atmosphere as ambient air is drawn through the system. This nitrogen loss represents a specific facet of macronutrient dynamics during composting, underscoring the need for careful management to mitigate such losses and optimize the nutrient composition of the final compost product.
- *Pathogen reductions or eliminations*
    - Rotating drum composting systems, with their tendency to maintain higher and consistent temperatures, offer an increased potential for pathogen elimination. The composting process can result in a substantial reduction of pathogens, up to 66% or more, in comparison to recycled manure solids that undergo no composting.
- *Air emissions*

- Rotating drum composting has shown a decrease in greenhouse gas (GHG) emissions by up to 66% because solids are kept out of the basin or lagoon where they would decompose and form methane. Using RMS as bedding reduces the need to truck sand or other bedding material to the farm and therefore reduces the associated GHG emissions. However, this technology loses nitrogen to the atmosphere in the form of ammonia gas.

- *Water emissions*
  - Drum composting provides a direct benefit to water quality impacts as it decreases leaching risks during storage and land application when compared with manure that has not been composted. The lighter, more nutrient dense compost allows for easier transport which reduces over-application and enables better distribution of nutrients. This in turn reduces leaching of nitrates into the groundwater providing environmental and human health benefits. Liquid effluent following solid separation can be land applied more efficiently and can allow the use of low pressure drop hose center-pivot manure applications.

PROCESS MONITORING AND CONTROL SYSTEM REQUIRMENTS

- *Required monitoring*— The drum is monitored for temperature, moisture levels, and volume, as well as any management practices that need refinement.
- *Equipment included for monitoring*— Sensors to track temperature, moisture levels, and weight within the drum to guide the settings of operating controls. Data logging captures historical trends for guiding operation.
- *Equipment included for controlling*— Programmable Logic Controller (PLC) controlled from mounted integrated control panel.

TYPICAL OPERATIONS/MAINTENANCE PLAN WITH MONITORING REQUIREMENTS AND REPLACEMENT SCHEDULE

This equipment has its own manufacture's O&M plan, monitoring requirements, and parts list with scheduled replacement. Component parts require maintenance and replacement per maintenance schedule. Daily inspections and periodic response to system upsets are required.

Operating and maintenance plans are large documents and difficult to include with this submission but would be available upon request from any technology provider as well as available on-site at a project. Electronic and/or hard copies could be made available for this review upon request.

CHEMICAL INFORMATION

Chemical inputs are not utilized within Drum Composting systems.

ESTIMATED INSTALLATION AND OPERATION COST

The following cost data is based on the FAN Bedding Recovery Unit (BRU) system and may not be indicative of all Drum Composting systems. Notably, differences will exist from specific technology providers and projects, but the range is an initial best effort of categorizing the costs by range across scales.

<u>Equipment and Installation Capital Costs</u>

As of 2023, the BRU-400 system is estimated at $223,080; the BRU-1000 is estimated at $380,380, and the BRU-2000 is estimated at $405,210, with an additional $20,000 if a pump and mixer are required.

<u>Operation and Maintenance Costs (O&M)</u>

- ***Electrical/Labor/Maintenance—***Operation costs vary widely across farms. $8,000-$20,000 per year in parts and maintenance, plus electricity usage. The modern units draw about 50 amps when fully operational.

EXAMPLE WARRANTY

Each technical approach commercialized within this class of technology will have its own warranty and warranty wording. However, expected warranties are as follows:

- Warranty against defects in the workmanship of equipment and components for a period of one (1) year from the date of installation.
- Obligation under warranty is limited to correcting, with no additional payment due from customer, any part or parts which shall be found defective or part or parts which have been installed improperly. Repair or replacement is at the vendor’s option.

- Vendor shall not be obligated to pay for, nor reimburse the customer for, the cost of unauthorized repairs.
- Technology specific performance guarantees are also available specific to throughput, dry matter, pathogen kill, etc. depending on the equipment.

RECOMMENDED RECORD KEEPING

A review of record keeping at facilities shows that beyond daily walk-through checklist items/observations related to the specific technology's operational procedures, the most often recorded information is as follows:

- Daily recording with time observation of temperatures within the drum.
- Daily recording with time observation of moisture content, oxygen content, and odor.
- Recording of type and quantity of moisture added that day.
- Estimated volume/mass of compost produced with discussion on quality.
- Recording of specific maintenance work done that day and any working observations/concerns.

Ideally, the daily checklist recordings on hard copy paper are memorialized via electronic scans with an Excel spreadsheet totalizing data overtime.

ALTERNATIVES FOR THE USE OF BYPRODUCTS

This technology class generates a compost by-product through the treatment of manure. Increasingly, dairy operations are opting for recycled manure solids (RMS) or composted solids as bedding in free stall barns to streamline costs and simplify the manure treatment process compared to using sand or alternative bedding materials. When not utilized as bedding on the dairy, the composted bedding is commonly sold to other farms for their bedding needs or used as a substitute for peat moss in potting soils.

INDEPENDENT VARIFIABLE DATA DEMONSTRATING RESULTS/CREDENTIALS

Appendix A is a summary of the independent review of peer-reviewed and technical data available for this class of technology and is available through Newtrient (2018). The Newtrient work involves an internal peer-review, comprised of ten national experts in the field of manure management, with the final output presently being prepared for external peer-review and publication. While the reference list is not a complete listing of all related peer-reviewed literature it does highlight key references specific to this class of technology and how it relates to key performance indicators within this NRCS Standard 317.

Appendix B is a summary of data obtained during a Newtrient-managed third-party review of a Drum Compost system at Fessenden Dairy in King Ferry, NY. The information was from a 15-week analysis of the system and its performance by Wells College—the work has not been peer-reviewed.

Appendix C is the complete Wells College report detailing the third-party review at Fessenden Dairy in King Ferry, NY.

CONTACT INFORMATION—VENDOR

While not an absolute conclusive list, the list below identifies vendors that are active in the application of this class of technology on manure projects within the U.S.

- *Nutrient Control Systems, Inc. – Bedding Recovery System*
  NCS's Dry Matter Bedding System (DMS) is a fully integrated equipment package including pump, mixer, dewatering press, and process controls capable of being operated by a smartphone. The system is modular and allows the addition of a unique device called the Hygenizing Bio-Cell. This system can produce either sanitized or green bedding depending upon the customer's objective. Either way the product is dry, consistent, and is a superior dairy bedding. Since the package is fully integrated, overall reliability is unsurpassed. Contact and product information available at: https://www.ncsysinc.com/
- *FAN Separator – Bedding Recovery System*
  As the costs for high quality bedding material have extremely risen in the last few years more and more innovative milk farms use bio bedding material. This is made of digested or undigested fibers (feed remains) of the slurry. The BRU concept (Bedding Recovery Unit) developed by FAN, a daughter of the Austrian company Bauer specialized in environmental technology, separates, dries and disinfects digested or undigested fibers of slurry. This way costs can be reduced and at the same time milk production is optimized. As this is an ecological cycle not only the costs for bedding material but also disposal costs can be saved. This

biological material is produced directly on the farm and is always available. Contact and product information available at: https://www.fan-separator.de/en/products/bedding-recovery-unit

- *DariTech, Inc. – Bedding Master Recovery System*
  Scraped manure, or dewatered flush manure, is fed directly into an EYS Separator specially designed by DariTech to provide the ideal feedstock for the BeddingMaster, which is made up of manure solids at 35% dry matter. The separated solids are fed into the BeddingMaster by passing through the fixed opening in the entry end. DariTech's stationary ends that do not rotate with the drum increase throughput by over 50%, resulting in more bedding for less money. Contact and product information available at: https://www.daritech.com/beddingmaster.html

CONTACT INFORMATION—USER

Thousands of dairies are separating solids, but we estimate that hundreds are using drum composters for bedding recovery/composting, with the adoption rate increasing. Known commercial facilities presently operating in the U.S. with this class of technology are identified below. The list is a best effort but may not be completely inclusive of all installations.

FAN Bedding Recovery Unit (BRU)

Fessenden Dairy – King Ferry, NY

OTHER CONSIDERATIONS

- Keys to success are a commitment to make RMS bedding work. There are many dairies that have converted successfully to RMS bedding and have not encountered significant increases in mastitis or somatic cell count.

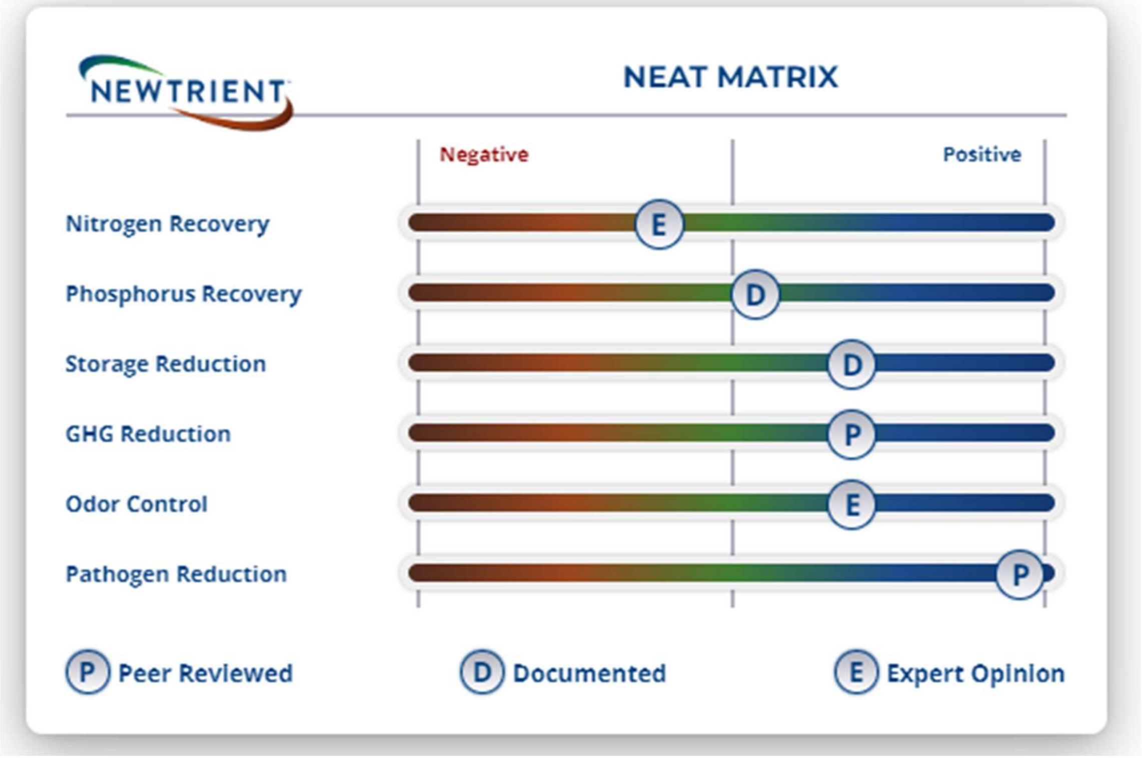
- Justification for installation of the technology most often comes via cost savings and reduced complexity of manure management.

CONCLUSION

Drum composting employs an insulated compost dryer that undergoes an intensive aerobic process to treat solids, effectively killing bacteria and drying the material. This ensures a uniform mixture in a controlled environment, transforming the chemistry of the manure to eliminate mastitis-producing microorganisms present in fresh manure, resulting in a safe and comfortable bedding product. Furthermore, drum compost systems have the potential to lower overall operational costs and provide a return on investment by avoiding expenditures on sand for bedding, sand separation equipment, and reducing overall manure handling costs.

Appendix A

NEWTRIENT CRITICAL INDICATOR ANALYSIS—DRUM COMPOSTER/BEDDING RECOVERY



Overall Summary

Drum Composting offers dairy farms a sustainable and cost-effective solution for manure management. By conditioning coarse manure fibers and utilizing in-vessel composter technology, these systems enhance bedding characteristics while providing proven benefits such as storage reduction, odor control, and decreased pathogens. Despite the loss of nitrogen in the form of ammonia gas, the technology contributes to a significant reduction in greenhouse gas emissions, as solids are diverted from basins or lagoons, preventing decomposition and methane formation. Additionally, there are no greenhouse gas emissions associated with the transportation of sand or other bedding materials to the farm.

With primary applications in bedding for free stall barns, the adoption rate is growing, driven by the potential for return on investment within a few years through cost savings. While capital costs are a consideration, low operating costs, reduced complexity, and environmental benefits make these systems increasingly attractive to dairy farmers. Success with recycled manure solids relies on a commitment to make it work, with many dairies reporting improved cow comfort and cleanliness. Overall, Drum Composting provides a comprehensive solution, addressing economic, environmental, and operational challenges in modern dairy farming.

Appendix B

Third-Party Review of FAN Bedding Recovery Unit at Fessenden Farm - King Ferry, NY (Report Summary)

University Partner
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OCTOBER 2023

BACKGROUND

Fessenden Dairy, a longstanding dairy operation in King Ferry, New York, has earned recognition for its pioneering efforts in dairy sustainability. Owned by Tim and Ronda Fessenden, the farm's commitment to environmental stewardship led to the implementation of an innovative manure management system. This system converts dairy manure solids into heat-treated bedding for cows. In an era of tight profit margins for dairy producers, the rising cost of traditional bedding materials and disposals prompted the adoption of Recycled Manure Solids (RMS) as an alternative. While RMS offers economic advantages, they can harbor pathogens, posing a challenge for cow health. The central objective of this project was to thoroughly assess the performance and effectiveness of the FAN BRU system in generating top-tier bedding material from RMS for the dairy.

Table 1. Fessenden Farm has been extensively studied by Cornell University for its innovative manure management system. (From Shelford et al. 2015)

Manure Management System Summary

Number of cows	650 lactating cows, 600 heifers
Uncovered manure storage dimensions	First stage: 82' x 175' x 14' Earthen Berm
Covered manure storage dimensions	Second stage: 365' x 175' x 14' Earthen Berm
Cover material	60 mil HDPE, Environmental fabrics inc.
Estimated total loading rate	16,000 gallons per day
Covered Storage Volume (total)	7,000,000 gallons
Solid-liquid separator	During study - FAN ™ Separators Currently - DODA™ Separators
Biogas utilization	Flare
Carbon credits sold/accumulated	Not currently being collected[1]
Stall bedding material	Separated manure solids
Year installed (cover)	2007

[1]Originally retained by Environmental Credit Corporation

This table has been updated with 2023 data.

INTRODUCTION

Fessenden Dairy partnered with FAN, a European company specializing in separation and slurry technology, to implement the FAN Bedding Recovery Unit (BRU) system. This system combines coarse solid separation and drum composting technologies to produce pathogen-free bedding from RMS, reducing operational costs and minimizing the farm's environmental impact. The process starts with solid-liquid separation as a pre-treatment for rotary drum composting. The RMS are then fed into a rotary drum composter, where they are dried for 1-3 days at around 70°C, utilizing constant aeration and agitation to reduce moisture, eliminate odors, and neutralize pathogens. The outcome is high-quality, homogenized bedding material, which is then transferred to a compost pile upon completion of processing.

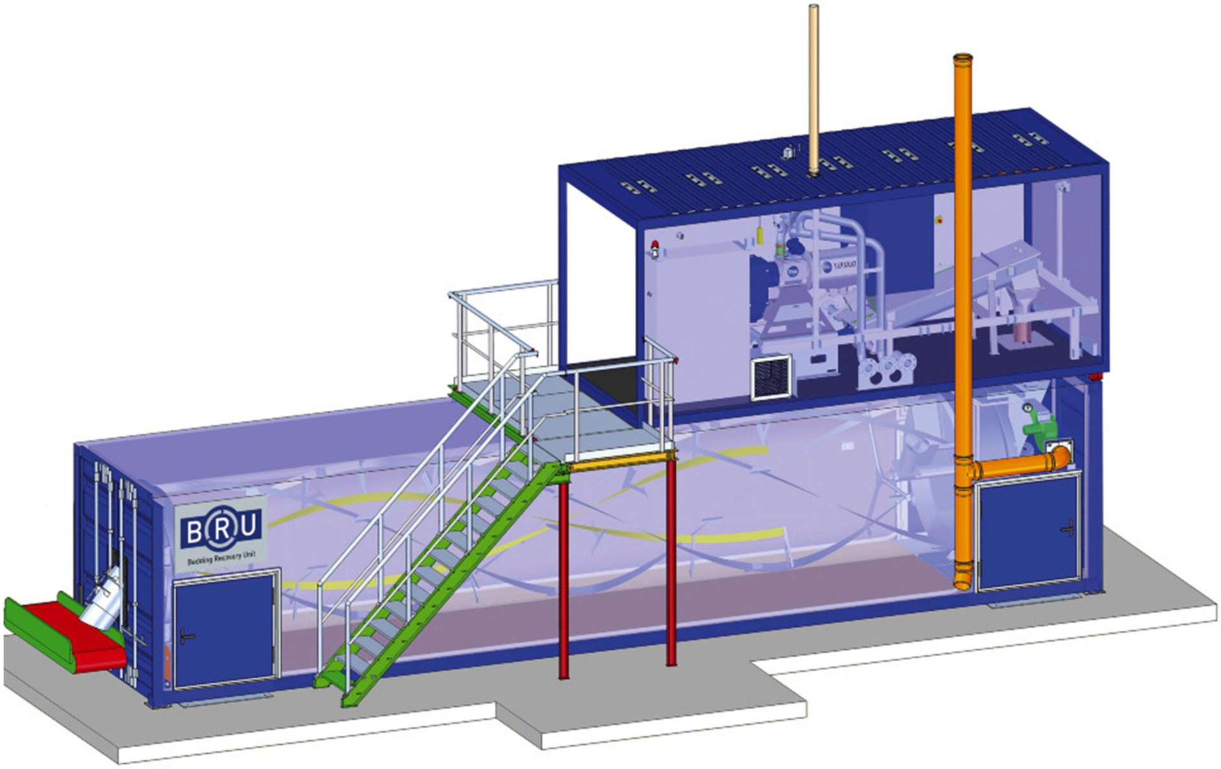

Figure 1. FAN Bedding Recovery Unit (BRU) System.

The FAN BRU system at Fessenden Dairy consists of a specially designed screw press on top of the 40-foot container containing the drum, isolated for heat protection, where an auger delivers the solids. The screw press can be in a 20-foot container located on top of the 40-foot container, isolated for low-temperature applications. The separator removes solids and minimizes humidity. The drum in this container can be filled with over 70% volume and has a ventilator for regulating the aerobic process, producing pathogen-free bedding. The FAN BRU continuously processes liquid manure from the 40' x 14' holding tank (Inflow), separating solids with a screw press, returning liquid manure to the holding tank

(Outflow), inputting solids into the FAN drying drum (Pre-compost), and transferring processed solids to the compost pile (Compost).

METHODOLOGY

Samples of the liquid influent going into the screw press, liquid effluent coming out of the screw press, solids coming from the screw press, and solids from the rotary drum were taken to assess the efficacy and performance of FAN BRU. For the entirety of the 15-week project, samples were taken three times a week, except in the last four weeks in which samples were taken twice a week. All samples were sent to A&L Great Lakes Laboratories for analyses. Three types of analyses were performed depending on the origin of the sample: a manure analysis, compost analysis, and an in-depth compost analysis.

The manure analysis was performed to test the differences in percentage of moisture, solids, ash, organic matter, organic carbon, organic nitrogen, and phosphorus between liquid influent and effluent. The compost analysis was performed to test the differences of the carbon to nitrogen ratio, pH, and the percentage of moisture, solids, total nitrogen, phosphorus, and potash between pre- and post-compost. The in-depth compost analysis was also performed to test the differences of the carbon to nitrogen ratio, pathogen colony-forming units (CFU), and the percentage of moisture, solids, total nitrogen, phosphorus, and metals between pre-and post-compost.

DISCUSSION OF RESULTS

KEY BENEFITS OF FAN BRU

Evaluation of the FAN BRU system's outcomes offers valuable insights into its operational efficiency, economic viability, pathogen reduction capabilities, and its role in minimizing the environmental footprint of a dairy.

Performance: Throughout the study, the FAN BRU system effectively processed liquid manure, with an average input rate of about 522 gallons per hour. The liquid outflow, which was returned to another holding tank, had an average rate of about 452 gallons per hour. The inside of the drum where the processing occurred maintained an average temperature of 174°F, while the compost pile's average temperature was 99.7°F, which did not necessarily match the outside temperature.

A comprehensive analysis of the samples was conducted to assess the quality of the compost produced by the FAN BRU unit. The results indicated that the removal of solids by the FAN BRU unit increased the moisture content in the outflow, as expected. Organic matter decreased, but most other measures remained consistent between inflow and outflow. Additionally, further treatment of the raw solids in the composting process led to a decrease in moisture between the pre-compost and compost samples.

These analyses collectively offer a comprehensive understanding of the FAN BRU system's performance and effectiveness in producing high-quality bedding material. Notably, the system consistently met expectations, as revealed by analytical data indicating increased solids as moisture was removed in both manure and compost analyses. Furthermore, the system's ability to achieve acceptable pathogen levels in post-compost samples reaffirms its contribution to safer and healthier bedding for Fessenden Dairy's cows, all while reducing input costs and minimizing the dairy's environmental footprint.

Cost Savings: The FAN BRU system operates in a circular manner, consistently producing top-quality bedding for the farm. This not only enhances cow comfort and boosts milk production but also leads to significant cost reductions related to bedding materials and waste disposal. Additionally, any surplus compost generated by the system can be sold externally to other farms as bedding or as potting soil and fertilizer, creating an additional income source for the farm. This integrated approach not only optimizes farm operations but also diversifies revenue streams, reinforcing the farm's financial sustainability.

Pathogen Reductions: The FAN BRU system demonstrated a remarkable reduction in the presence of harmful pathogens in the compost, transitioning from initially high levels to nearly undetectable amounts. In the March in-depth compost analysis, the presence of fecal coliform was measured at 4,390 CFU per gram (indicating a fail) in the pre-compost, and a significant reduction to 20 CFU per gram (indicating a pass) in the post-compost stage. Similarly, during the June analysis, the pre-compost exhibited a presence of 4,180 CFU per gram (also indicating a fail), while the post-compost showed less than 2 CFU per gram (a pass). Utilizing bedding material with such substantial reductions in pathogens ensures a safer and healthier environment for the cows.

Environmental Footprint: In addition to performance and economic benefits, the FAN BRU system plays a pivotal role in reducing the farm's environmental footprint. Drum composting has been shown to contribute to a significant decrease in greenhouse gas (GHG) emissions (Fillingham et al., 2017). By recycling manure solids instead of storing them in large basins or lagoons and reducing the need for trucking sand to the farm, the system mitigates methane (CH_4) and carbon dioxide (CO_2) emissions. In addition, the generation of a more nutrient dense, lighter compost reduces the risk for leaching nitrates into groundwater during land-application and storage. The resulting compost product eases transportation of the fertilizer and allows for a better distribution of nutrients on the field during application. Liquid effluent collected after separation can also be used as fertilizer on land-applications, fit for the use of efficient low-pressure drop nozzles.

Table 2: In-depth Compost analysis – MARCH - all values are in percentages

SAMPLE	MOISTURE	SOLIDS	TOTAL NITROGEN	PHOSPHORUS	METALS	FECAL COLIFORM	C:N
PRECOMPOST	63.52	36.48	0.46	0.06	Pass	4390 (Fail)	38.9:1
COMPOST	56.29	43.71	0.58	0.07	Pass	20 (Pass)	36.7:1
DIFFERENCE	7.23	-7.23	-0.12	-0.01			2.2

Table 3: In-depth Compost analysis – JUNE - all values are in percentages

SAMPLE	MOISTURE	SOLIDS	TOTAL NITROGEN	PHOSPHORUS	METALS	FECAL COLIFORM	C:N
PRECOMPOST	61.7	38.3	0.53	0.09	Pass	4180 (Fail)	35.2:1
COMPOST	58.31	41.69	0.56	0.11	Pass	<2 (Pass)	36.4:1
DIFFERENCE	3.39	-3.39	-0.03	-0.02			-1.2

KEY ISSUES AND CHALLENGES

During the study, several key operational issues were identified and addressed as outlined below.

Air Emissions: One of the primary challenges associated with these systems is the direct emissions of exhaust, such as ammonia, volatile organic compounds (VOCs), and CO_2 into the atmosphere, typically without the use of emission control devices. This can contribute to air quality concerns and environmental impacts.

Ammonia Nitrogen Volatilization: Long-term research on manure composting has revealed the potential for significant ammonia nitrogen volatilization, ranging from 8% to 43%. While not explicitly studied in the context of drum composting, it is presumed that ammonia volatilization may also occur, posing a potential challenge for nutrient management.

Odor Release: The emission of volatile carbon and sulfur compounds is likely to result in odor release from these systems. Managing and mitigating these odors is crucial to address potential environmental and community concerns.

IMPLICATIONS

Drum composting holds significant implications for enhancing sustainability and efficiency in the dairy industry. Notably, the successful conversion to RMS bedding, as demonstrated by many dairies without encountering notable increases in mastitis or somatic cell counts, highlights the feasibility and advantages of this sustainable bedding approach. The primary driver for adopting such technology lies in the compelling cost savings and simplified manure management it offers, which justify its installation. To enhance the effectiveness of the FAN BRU system and promote optimal drum composting technology while reducing GHGs directly into the atmosphere, further research on integrating an emission control device is essential. Such a device would serve to restrict the release of carbon and sulfur emissions during odor release and minimize the volatilization of ammonia, which is presumed to occur during drum composting. By achieving reductions in nutrient levels, heavy metals, and the elimination of pathogens, FAN BRU is an innovative, sustainable, and feasible approach for utilizing RMS as bedding in dairy operations.

For additional information on the vendor, environmental impacts, financial implications, and FAN BRU technology visit the FAN BRU Vendor Snapshot on the Newtrient website.

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Appendix C

ANALYSIS OF THE FAN-BEDDING RECOVERY UNIT AT FESSENDEN FARM DAIRY, KING FERRY, NY (FULL REPORT)

Prepared by: Dr. Jaclyn Schnurr

INTRODUCTION

Fessenden Farm Dairy, located in King Ferry NY, has been in existence since 1863. They currently have 650 dairy cows (Table 1, Shelford et al. 2015). To recycle the large amount of manure that is produced each year, the farm has invested in a FAN-Bedding Recovery Unit (called Big John), a drum composter that composts solid waste products into a usable form of bedding to be used for its cows. Fifty percent of the manure produced is used as bedding, while the other half is sold off site as garden compost. By composting the manure on site, Fessenden farm is decreasing the amount of runoff that occurs into nearby lakes and rivers, allowing for increased water quality in the Finger Lakes region of NY.

The FAN BRU constantly runs, inputting liquid manure from the 40’ x 14’ holding tank, separating solids from the slurry by a continually running screw press, returning liquid manure to the holding tank and inputting solids into the FAN drying drum. In the drum the solids are aerobically digested, reducing pathogens, and drying the product to be used for bedding. The bedding is then stored in piles that are removed by tractor and used in the barns. By recycling manure and composting solids to create bedding for the cows, the FAN BRU decreases the opportunity for nutrient runoff.

Table 1: Fessenden Farm has been extensively studied by Cornell University for its innovative manure management system. (From Shelford et al. 2015)

Manure Management System Summary

Number of cows	650 lactating cows, 600 heifers
Covered Manure Storage Dimensions	First Stage: 82' x 175' x 14' Earthen Berm Second Stage: 365' x 175' x 14' Earthen Berm
Cover material	60 mil HDPE, Environmental Fabrics Inc.
Estimated total loading rate	16,000 gallons per day
Covered Storage Volume (total)	7,000,000 gallons
Solid-liquid separator	2 systems in Parallel, DODA™ and FAN™ Separators
Biogas utilization	Flare
Carbon credits sold/accumulated	Not Being Collected[1]
Stall bedding material	Separated Manure Solids
Year installed (cover)	2007

[1] *Originally retained by Environmental Credit Corporation*

METHODS

This current study was undertaken by Newtrient, Inc. to determine the quality of the bedding produced by the Bedding Recovery Unit. Wells College was contracted to sample 3 times a week for 15 weeks, starting March 4, 2022, and ending June 6, 2022. The final 4 weeks of sampling only 2 samples were taken each week due to the end of the semester and the graduation of 2 of the 3 student interns involved in the project. There were 36 total weekly samples taken. Additionally, at the start and the end of the project 2 additional compost samples were taken to analyze the effects of the digester more thoroughly on the creation of bedding.

The samples were sent to A&L Great Lakes Laboratory for compost and manure analysis. Both solid and liquid samples were collected: one liquid manure sample from the open holding tank (labelled INFLOW on Figure 1), one liquid manure sample from the outflow after separation of the solids and liquids in the Bedding Recovery Unit (OUTFLOW), one solid manure sample from the Bedding Recovery Unit prior to digestion (PRECOMPOST), and one solid sample from the compost pile post digestion (COMPOST).

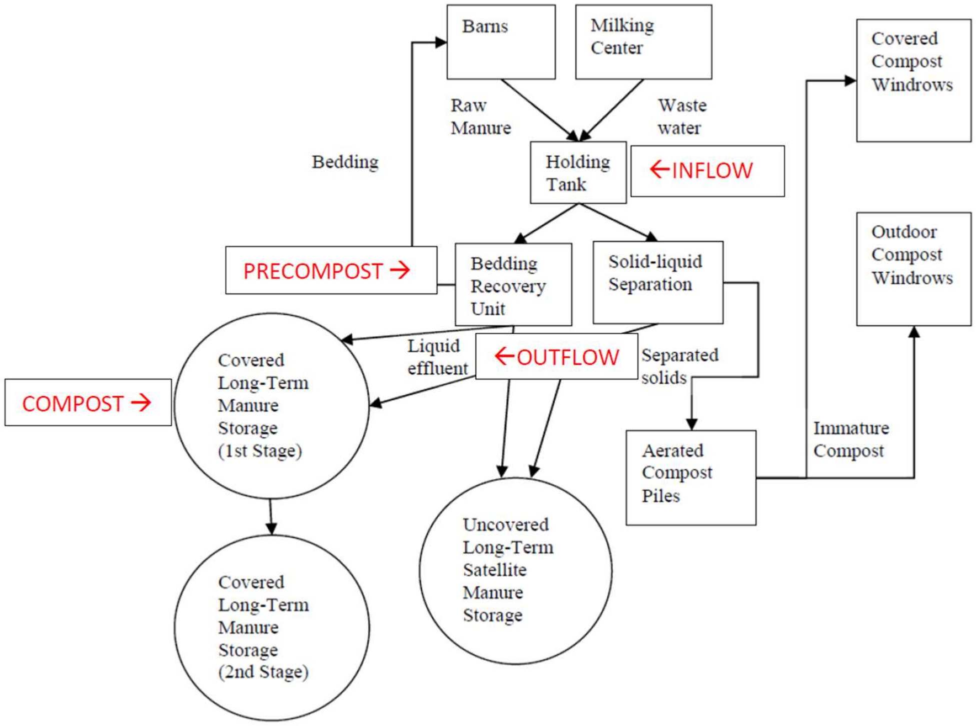

Figure 1. Fessenden Dairy Manure Management System Process Flow Diagram. (From Shelford et al. 2015)

A log was kept documenting the outside temperature, relative humidity, depth of the holding tank (as a measure of flow rate to the FAN BRU), outflow rate from the FAN BRU, and temperature of the compost pile for each sample day.

RESULTS

As expected, temperatures increased during the study, reflecting seasonal changes (Figure 2).

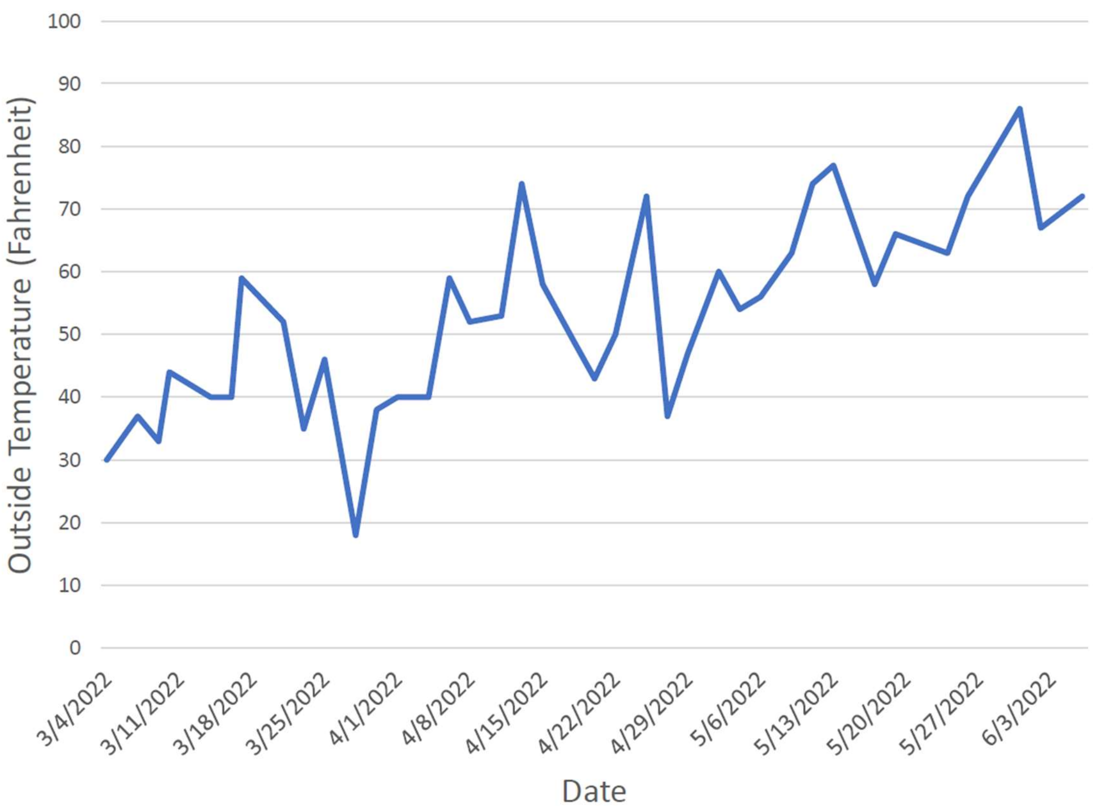

Figure 2: Daily outside temperatures (in °F) for the duration of the study as provided by a weather application on a smartphone.

Relative humidity remained consistent for the duration of the study (Figure 3).

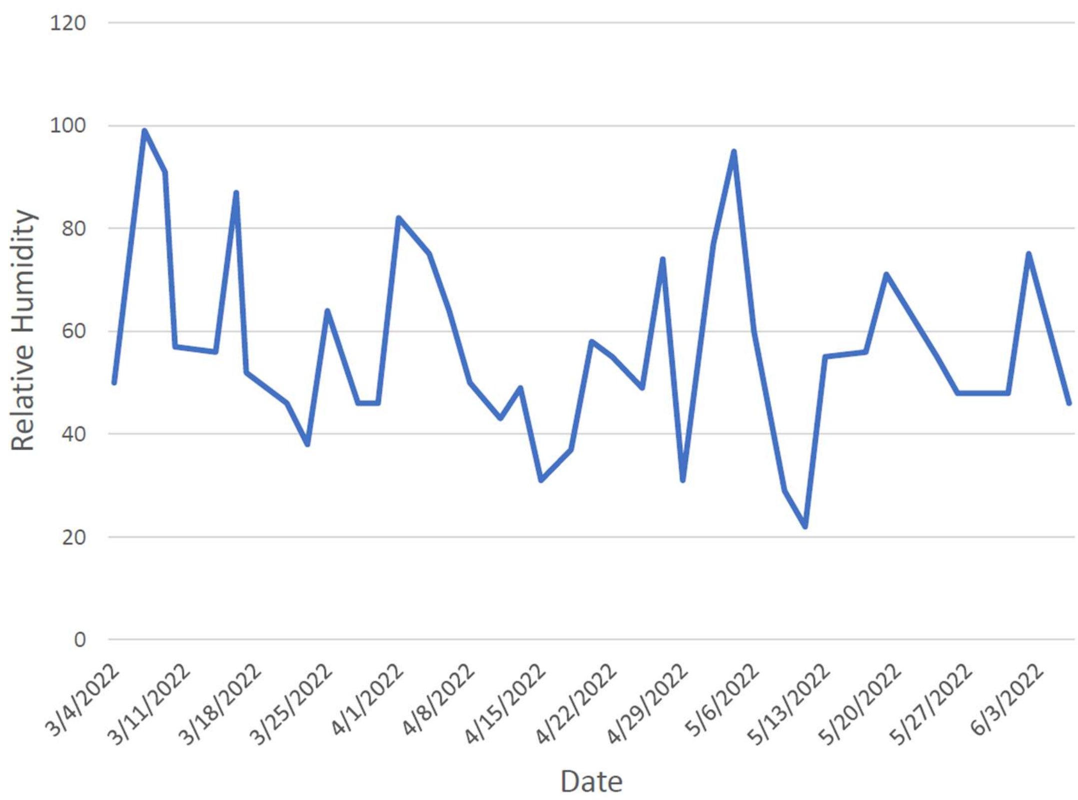

Figure 3: Daily relative humidity for the duration of the study as provided by a weather application on a smartphone

Liquid manure was removed from the holding tank and inputted into the FAN BRU at an average rate of 1.5 ± 1.7 inches/hour (mean ± standard deviation), which translates into roughly 522 gallons/hour. Liquid outflow was returned to the holding tank at an average rate of about 4.12 ± 1.6 seconds per gallon, or about 452 gallons/hour. The average temperature of the digestor drum was 174.2 ± 13.5°F. Temperature of the compost pile was very variable, averaging 99.7 ± 27.6°F. However, it didn't reflect the outside temperature (Figure 4).

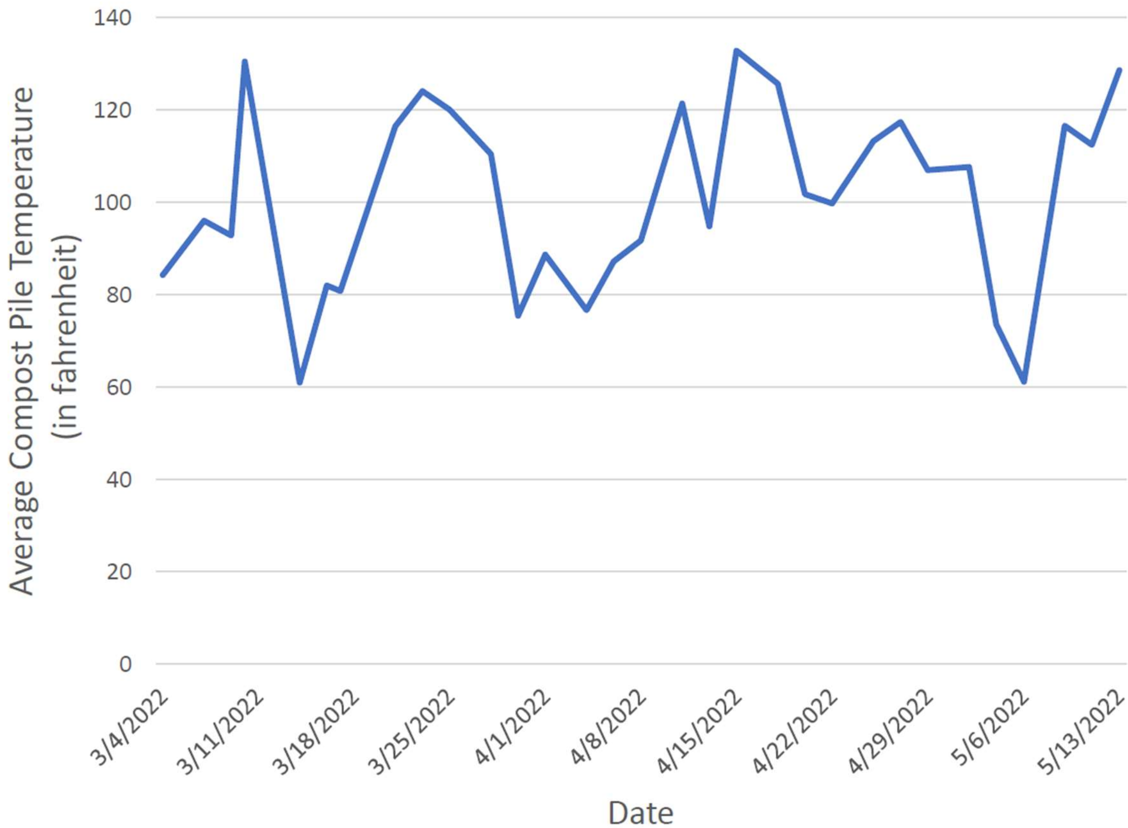

Figure 4: Average temperature (°F) of the compost pile, measured at 5 different locations with the pile and then averaged.

Samples were analyzed for many different chemical constituents (Appendices 1-4 for all the data plus averages and standard errors). Comparisons of the average values for important measures of compost health were made to determine how efficient the FAN BRU was in creating cow bedding. Removal of the solids by the FAN BRU unit increased the amount of moisture in the OUTFLOW, as would be expected (Table 2). Organic matter also decreased, but most other measures remained consistent between inflow and outflow (Table 2). Similarly, composting of the raw solids caused a further decrease in moisture between the pre-compost and the compost sample (Table 3) along with negligible changes in the other measures.

The more in-depth sample analysis demonstrated that treatment of the compost in the FAN BRU unit decreased the presence of fecal coliform bacteria from an unacceptable level to almost non-detectable levels (Table 4 for March and Table 5 for June). There were no differences between the March and the June samples.

Table 2: Manure analysis – all values are in percentages

SAMPLE	MOISTURE	SOLIDS	ASH	ORGANIC MATTER	ORGANIC CARBON	ORGANIC NITROGEN	PHOSPHORUS
INFLOW	92.28	7.72	1.36	6.35	3.68	0.2	0.04
OUTFLOW	94.7	5.26	1.35	4.0	3.32	0.19	0.05
DIFFERENCE	-2.42	2.46	0.01	2.35	0.36	0.01	-0.01

Table 3: Compost analysis – all values are in percentages

SAMPLE	MOISTURE	SOLIDS	TOTAL NITROGEN	PHOSPHORUS	POTASH	PH	C:N
PRECOMPOST	61.29	38.7	0.49	0.07	0.31	7.54	37.2:1
COMPOST	58.73	41.26	0.57	0.08	0.34	7.88	34.8:1
DIFFERENCE	2.56	-2.56	-0.08	-0.01	-0.03	-0.34	2.4

Table 4: In-depth Compost analysis – MARCH - all values are in percentages

SAMPLE	MOISTURE	SOLIDS	TOTAL NITROGEN	PHOSPHORUS	METALS	FECAL COLIFORM	C:N
PRECOMPOST	63.52	36.48	0.46	0.06	Pass	4390 (Fail)	38.9:1
COMPOST	56.29	43.71	0.58	0.07	Pass	20 (Pass)	36.7:1
DIFFERENCE	7.29	-7.23	-0.12	-0.01			2.2

Table 5: In-depth Compost analysis – JUNE - all values are in percentages

SAMPLE	MOISTURE	SOLIDS	TOTAL NITROGEN	PHOSPHORUS	METALS	FECAL COLIFORM	C:N
PRECOMPOST	61.7	38.3	0.53	0.09	Pass	4180 (Fail)	35.2:1
COMPOST	58.31	41.69	0.56	0.11	Pass	<2 (Pass)	36.4:1
DIFFERENCE	3.39	-3.39	-0.03	-0.02			-1.2

CONCLUSION

In our analysis of the data, the FAN BRU unit at Fessenden Dairy performs as would be expected. The bedding that is created is free of pathogens, does not have large amounts of metals or other nutrients, and appropriate for the maintenance of healthy cows.

By recycling manure at Fessenden Farm, the farm not only saves on bedding costs but also helps decrease the impact on the environment. Dairy farms can have large impacts on climate, through the production of methane, and water quality, especially in the Finger Lakes region. Fessenden Farm can decrease impacts on methane since decomposition of manure can produce methane, and water quality by composting the manure and reusing it as bedding, decreasing the amount of manure that needs to be stored on holding ponds, which may overflow, or is spread on farm fields and may runoff into water supplies. The compost is free of pathogens and is in a biologically usable form, allowing for sustainable farming in the Finger Lakes. Finally, transporting dry compost is cheaper and allows for easier transport of materials. In conclusion, the FAN BRU unit at Fessenden Farm is a creative and economical way to deal with the large amounts of manure that is produced on a dairy farm, decreasing the impacts on water quality as well as the costs associated with maintaining a dairy farm.

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Date	Moisture	Solids	Ash	Organic Matter	Organic C	TKN	Ammonium	Organic N	Phosphorus	Potassium	Sulfur	Magnesium	Calcium	Sodium	Aluminum	Copper	Iron	Manganese	Zinc
3/4/2022	92.06	7.94	1.32	6.62	3.84	0.366	0.14	0.226	0.041	0.267	0.03	0.06	0.14	0.08	21	46	38	11	16
3/7/2022	92.09	7.91	1.3	6.61	3.83	0.346	0.15	0.196	0.042	0.254	0.04	0.06	0.13	0.08	18	58	35	11	15
3/9/2022	92.99	7.01	1.28	5.73	3.32	0.325	0.14	0.185	0.04	0.259	0.04	0.06	0.13	0.09	14	44	34	11	15
3/10/2022	92.21	7.79	1.24	6.55	3.8	0.332	0.14	0.192	0.039	0.242	0.03	0.05	0.13	0.08	17	44	46	11	16
3/14/2022	91.77	8.23	1.35	6.88	3.99	0.394	0.16	0.234	0.045	0.283	0.04	0.06	0.13	0.09	15	51	43	12	17
3/16/2022	91.39	8.61	1.38	7.23	4.2	0.38	0.15	0.23	0.04	0.291	0.04	0.06	0.14	0.09	17	58	44	12	16
3/17/2022	91.83	8.17	1.31	6.86	3.98	0.358	0.15	0.208	0.046	0.289	0.04	0.06	0.14	0.09	17	748	43	12	16
3/21/2022	92.58	7.42	1.26	6.16	3.57	0.324	0.12	0.204	0.044	0.27	0.04	0.06	0.13	0.09	14	62	42	11	16
3/23/2022	95.35	4.65	1.21	3.44	1.99	0.318	0.14	0.178	0.045	0.274	0.04	0.06	0.12	0.1	12	66	31	10	15
3/25/2022	93.76	6.21	1.2	5.01	2.9	0.338	0.14	0.198	0.04	0.252	0.04	0.05	0.11	0.12	13	85	31	11	14
3/28/2022	92.76	7.24	1.38	5.86	3.4	0.36	0.14	0.22	0.044	0.272	0.04	0.06	0.13	0.1	14	85	37	12	16
3/30/2022	91.96	8.04	1.45	6.59	3.82	0.367	0.15	0.217	0.045	0.268	0.04	0.06	0.14	0.11	15	60	42	13	17
4/1/2022	91.81	8.19	1.42	6.77	3.93	0.367	0.15	0.217	0.045	0.281	0.05	0.06	0.14	0.09	16	70	39	13	18
4/4/2022	92.3	7.7	1.26	6.44	3.74	0.342	0.17	0.172	0.041	0.252	0.04	0.06	0.13	0.08	15	54	37	11	16
4/6/2022	95.32	4.68	1.19	3.49	2.02	0.309	0.14	0.169	0.039	0.212	0.04	0.05	0.11	0.08	12	66	28	10	13
4/8/2022	92.51	7.49	1.32	6.17	3.58	0.333	0.14	0.193	0.042	0.282	0.04	0.06	0.14	0.08	22	47	51	12	16
4/11/2022	92.47	7.53	1.38	6.15	3.57	0.344	0.15	0.194	0.046	0.278	0.04	0.07	0.15	0.11	18	107	47	14	18
4/15/2022	91.3	8.7	1.45	7.25	4.2	0.363	0.14	0.223	0.054	0.308	0.05	0.07	0.16	0.1	17	84	47	16	23
4/18/2022	93.06	6.94	1.21	5.73	3.32	0.324	0.14	0.184	0.047	0.273	0.04	0.06	0.13	0.09	17	69	38	13	18
4/20/2022	92.51	7.49	1.18	6.31	3.66	0.337	0.14	0.197	0.049	0.263	0.04	0.06	0.13	0.09	14	73	41	13	17
4/22/2022	91.91	8.09	1.25	6.84	3.96	0.323	0.14	0.183	0.05	0.27	0.04	0.06	0.14	0.09	17	76	42	14	18
4/25/2022	91.66	8.34	1.45	6.89	4	0.356	0.15	0.206	0.058	0.33	0.05	0.07	0.15	0.13	17	122	47	16	22
4/27/2022	91.58	8.42	1.49	6.93	4.02	0.37	0.15	0.22	0.05	0.329	0.05	0.07	0.15	0.12	17	58	46	14	18
4/29/2022	91.88	8.12	1.58	6.54	3.79	0.355	0.17	0.185	0.053	0.363	0.06	0.08	0.16	0.14	21	85	67	14	19
5/4/2022	92.41	7.59	1.24	6.35	3.68	0.322	0.12	0.202	0.041	0.257	0.04	0.06	0.13	0.11	24	42	45	12	15
5/6/2022	93.18	6.82	1.3	5.52	3.2	0.327	0.14	0.187	0.056	0.258	0.04	0.06	0.13	0.1	17	55	40	13	18
5/9/2022	91.78	8.22	1.44	6.78	3.93	0.36	0.16	0.2	0.058	0.309	0.05	0.07	0.15	0.1	23	63	49	15	18
5/11/2022	92.02	7.98	1.45	6.53	3.79	0.372	0.15	0.222	0.059	0.311	0.05	0.07	0.14	0.12	18	64	52	15	18
5/13/2022	91.22	8.78	1.56	7.22	4.19	0.368	0.16	0.208	0.056	0.316	0.04	0.07	0.14	0.1	23	79	49	14	23
5/17/2022	91.41	8.59	1.7	6.89	4	0.359	0.16	0.199	0.053	0.344	0.05	0.07	0.13	0.13	14	61	40	13	17
5/19/2022	90.93	9.07	1.53	7.54	4.37	0.363	0.17	0.193	0.058	0.348	0.05	0.08	0.17	0.11	25	54	50	16	19
5/24/2022	92.4	7.6	1.32	6.28	3.64	0.307	0.14	0.167	0.05	0.292	0.04	0.06	0.13	0.09	18	40	36	14	16
5/26/2022	92.14	7.86	1.35	6.51	3.78	0.316	0.13	0.186	0.057	0.297	0.05	0.06	0.14	0.08	21	76	45	15	19
5/31/2022	91.51	8.49	1.42	7.07	4.1	0.335	0.14	0.195	0.054	0.303	0.04	0.07	0.16	0.1	25	60	55	14	18
6/2/2022	91.91	8.09	1.4	6.69	3.88	0.329	0.15	0.179	0.058	0.323	0.05	0.07	0.15	0.11	22	53	51	15	21
6/6/2022	92.2	7.8	1.52	6.28	3.64	0.348	0.15	0.198	0.057	0.276	0.05	0.07	0.14	0.12	18	100	45	14	20
AVERAGE	92.2825	7.716667	1.363611	6.353055556	3.684166667	0.345472	0.14638889	0.199083	0.0483889	0.286	0.043056	0.06333333	0.138056	0.099722	17.72222	85.13889	43.13889	12.972222	17.41667
ERROR	0.158987	0.15921	0.020656	0.146532308	0.085209709	0.003599	0.001958	0.002908	0.0011235	0.005409	0.00104	0.00119523	0.002176	0.002716	0.602391	19.1871	1.259348	0.2858741	0.384986

Appendix 1: INFLOW data collected at Fessenden Farm, King Ferry, NY. Error is standard error.

Date	Moisture	Solids	Ash	Organic Matter	Organic C	TKN	Ammonium	Organic N	Phosphorus	Potassium	Sulfur	Magnesium	Calcium	Sodium	Aluminum	Copper	Iron	Manganese	Zinc
3/4/2022	94.98	5.02	1.25	3.77	2.19	0.335	0.15	0.185	0.045	0.249	0.04	0.05	0.13	0.08	16	51	39	12	18
3/7/2022	95.12	4.88	1.24	3.64	2.11	0.323	0.16	0.163	0.043	0.252	0.03	0.05	0.13	0.09	14	62	35	11	16
3/9/2022	95.5	4.5	1.25	3.25	1.89	0.316	0.18	0.136	0.04	0.244	0.03	0.05	0.12	0.08	13	42	32	10	14
3/10/2022	95.17	4.83	1.15	3.68	2.13	0.315	0.15	0.165	0.043	0.238	0.04	0.05	0.13	0.09	15	49	35	11	16
3/14/2022	94.23	5.77	1.38	4.39	2.54	0.362	0.16	0.202	0.051	0.293	0.04	0.06	0.14	0.09	16	54	39	13	18
3/16/2022	94.4	5.6	1.25	4.35	2.52	0.367	0.16	0.207	0.049	0.239	0.04	0.06	0.14	0.09	18	71	42	13	19
3/17/2022	95.31	4.69	1.57	3.12	1.81	0.355	0.15	0.205	0.047	0.305	0.04	0.06	0.13	0.1	13	47	33	11	15
3/21/2022	95.29	4.71	1.24	3.47	2.01	0.309	0.13	0.179	0.041	0.247	0.03	0.05	0.12	0.08	11	45	27	10	13
3/23/2022	92.63	7.37	1.2	6.17	3.58	0.32	0.14	0.18	0.04	0.245	0.03	0.05	0.12	0.08	12	67	34	10	14
3/25/2022	94.98	5.02	1.25	3.77	2.19	0.326	0.14	0.186	0.042	0.224	0.04	0.06	0.12	0.09	13	76	33	10	15
3/28/2022	94.44	5.56	1.39	4.17	2.42	0.35	0.14	0.21	0.044	0.254	0.04	0.06	0.13	0.1	14	89	36	12	17
3/30/2022	94.18	5.82	1.41	4.41	2.56	0.364	0.16	0.204	0.048	0.267	0.04	0.07	0.14	0.11	16	56	38	13	18
4/1/2022	94.35	5.65	1.39	4.26	2.47	0.354	0.15	0.204	0.047	0.25	0.04	0.06	0.13	0.1	16	76	36	13	18
4/4/2022	95.19	4.81	1.2	3.61	2.09	0.318	0.15	0.168	0.04	0.238	0.04	0.05	0.12	0.08	14	47	30	10	14
4/6/2022	92.31	4.69	1.19	6.5	3.77	0.32	0.13	0.19	0.039	0.225	0.04	0.05	0.13	0.08	18	69	36	11	15
4/8/2022	95.16	4.84	1.25	3.59	2.08	0.313	0.14	0.173	0.041	0.279	0.03	0.05	0.13	0.1	16	61	37	13	16
4/11/2022	94.7	5.3	1.27	4.03	2.34	0.34	0.14	0.2	0.046	0.254	0.04	0.06	0.13	0.1	16	105	42	15	18
4/15/2022	94.25	5.75	1.42	4.33	2.51	0.346	0.15	0.196	0.059	0.279	0.05	0.08	0.15	0.11	18	99	47	18	22
4/18/2022	95.3	4.7	1.29	3.41	1.98	0.33	0.18	0.15	0.05	0.28	0.04	0.07	0.13	0.09	14	74	35	15	17
4/20/2022	95.15	4.85	1.28	3.57	2.07	0.326	0.15	0.176	0.05	0.257	0.04	0.07	0.12	0.1	15	71	35	14	17
4/22/2022	95.16	4.84	1.22	3.62	2.1	0.307	0.14	0.167	0.056	0.26	0.04	0.07	0.12	0.1	14	73	35	15	19
4/25/2022	94.37	5.63	1.41	4.22	2.45	0.357	0.16	0.197	0.061	0.303	0.05	0.08	0.14	0.11	19	106	44	17	21
4/27/2022	94.3	5.7	1.42	4.28	2.48	0.389	0.16	0.229	0.058	0.317	0.05	0.08	0.15	0.11	17	67	41	16	20
4/29/2022	94.36	5.64	1.36	4.28	2.48	0.346	0.16	0.186	0.06	0.28	0.05	0.08	0.14	0.1	23	102	47	17	20
5/4/2022	95.32	4.68	1.3	3.38	1.96	0.311	0.14	0.171	0.051	0.265	0.04	0.06	0.12	0.1	17	53	33	13	15
5/6/2022	95.2	4.8	1.45	3.39	1.94	0.316	0.15	0.166	0.056	0.274	0.04	0.07	0.12	0.1	11	46	35	15	17
5/9/2022	94.43	5.57	1.38	4.19	2.43	0.351	0.14	0.211	0.063	0.281	0.05	0.08	0.14	0.12	18	66	41	16	18
5/11/2022	94.51	5.49	1.38	4.11	2.38	0.34	0.15	0.19	0.062	0.281	0.05	0.08	0.14	0.11	13	62	41	16	18
5/13/2022	94.45	115.2	1.38	4.17	2.42	0.37	0.16	0.21	0.053	0.26	0.04	0.06	0.13	0.09	19	71	39	13	16
5/17/2022	94.6	5.4	1.55	3.85	2.23	0.357	0.16	0.197	0.056	0.355	0.05	0.07	0.14	0.11	17	56	40	14	18
5/19/2022	94.16	5.84	1.46	4.38	2.54	0.359	0.16	0.199	0.06	0.301	0.05	0.09	0.15	0.13	20	52	46	19	21
5/24/2022	95.02	4.98	1.24	3.74	2.17	0.318	0.14	0.178	0.052	0.276	0.04	0.07	0.13	0.08	19	47	39	16	18
5/26/2022	94.87	5.13	1.33	3.8	2.2	0.306	0.13	0.176	0.055	0.291	0.04	0.07	0.13	0.12	16	65	37	14	17
5/31/2022	94.9	5.1	1.62	3.48	2.02	0.311	0.14	0.171	0.056	0.256	0.04	0.07	0.14	0.1	18	61	45	15	18
6/2/2022	94.65	5.35	2.01	3.34	1.94	0.312	0.14	0.172	0.056	0.257	0.04	0.06	0.13	0.1	18	52	44	15	19
6/6/2022	97.47	5.53	1.28	4.25	2.46	0.349	0.15	0.199	0.07	0.218	0.05	0.08	0.15	0.07	20	99	50	19	22
AVERAGE	94.73361	8.312222	1.351667	3.999166667	2.3183333	0.335778	0.1497222	0.18605556	0.0508333	0.2665	0.041111	0.0647222	0.132222	0.096944	16.02778	66.36111	38.27778	13.75	17.41667
ERROR	0.136303	3.055283	0.026417	0.114928808	0.0667398	0.003666	0.0020113	0.00324354	0.0013271	0.004716	0.001037	0.0019308	0.001599	0.002247	0.453358	3.023756	0.861533	0.43163587	0.37665

Appendix 2: OUTFLOW data collected at Fessenden Farm, King Ferry, NY. Error is standard error

Date	Moisture	Solids	Total N	Phosphorus	Phosphate	Potassium	Potash	Sulfur	Magnesium	Calcium	Sodium	Iron	Aluminum	Copper	Manganese	Zinc	pH	Soluble Salts	Ash	Organic Matter	Total C	C:N
3/4/2022	63.51	36.49	0.5	0.07	0.15	0.27	0.32	0.09	0.19	0.55	0.07	0.02	0.01	90	26	41	8.5	3.65	0.01	36.48	18.24	36.5
3/7/2022	59.26	40.74	0.47	0.07	0.16	0.24	0.29	0.1	0.31	0.81	0.07	0.02	0.004	119	28	41	8.2	2.18	1.39	39.35	19.68	41.6
3/10/2022	66.4	33.6	0.44	0.06	0.13	0.25	0.29	0.08	0.14	0.49	0.07	0.01	0.003	85	25	36	7.5	5.45	1.32	32.28	16.14	36.4
3/14/2022	56.74	43.26	0.55	0.07	0.17	0.28	0.33	0.1	0.2	0.59	0.07	0.03	0.004	110	32	46	7.7	4.18	3.73	39.53	19.77	36
3/16/2022	61.68	38.32	0.49	0.06	0.14	0.27	0.32	0.09	0.16	0.51	0.07	0.02	0.004	118	27	39	7.4	5.53	1.8	36.52	18.26	36.9
3/17/2022	63.36	36.64	0.45	0.06	0.14	0.27	0.32	0.08	0.15	0.43	0.07	0.02	0.01	99	27	39	7.9	2.03	0.72	35.92	17.96	39.5
3/21/2022	62.03	37.97	0.47	0.06	0.13	0.24	0.29	0.08	0.18	0.54	0.06	0.02	0.01	98	25	38	7.7	4.27	2.91	35.06	17.53	37.5
3/23/2022	61.51	38.49	0.47	0.05	0.12	0.22	0.27	0.09	0.15	0.4	0.07	0.01	0.004	134	20	38	7.7	6.35	0.3	38.19	19.09	41
3/25/2022	59.71	40.29	0.5	0.06	0.15	0.23	0.28	0.09	0.17	0.43	0.06	0.01	0.004	168	24	42	7.4	4.42	2.76	37.53	18.76	37.9
3/28/2022	58.12	41.88	0.54	0.07	0.15	0.26	0.31	0.1	0.19	0.51	0.07	0.02	0.004	157	27	42	7	4.98	1.59	40.29	20.14	37.6
3/30/2022	58.64	41.36	0.53	0.06	0.14	0.28	0.33	0.09	0.15	0.45	0.08	0.01	0.004	99	26	39	7.9	2.87	1.35	40.01	20.01	37.5
4/1/2022	57.53	42.47	0.52	0.06	0.14	0.25	0.3	0.11	0.22	0.59	0.07	0.03	0.004	131	28	41	7.1	4.75	0.64	41.83	20.92	40.4
4/4/2022	60.88	39.12	0.5	0.06	0.14	0.24	0.29	0.09	0.18	0.56	0.07	0.02	0.004	111	27	41	7.1	4.08	0.7	38.42	19.21	38.4
4/6/2022	60.93	39.07	0.5	0.06	0.14	0.22	0.26	0.09	0.17	0.48	0.06	0.02	0.01	147	25	42	7.4	3.39	1.07	38	19	37.7
4/8/2022	60.27	39.73	0.48	0.07	0.16	0.23	0.28	0.1	0.2	0.61	0.06	0.03	0.01	120	30	46	7.2	5.35	1.68	38.05	19.03	39.3
4/11/2022	58.11	41.89	0.51	0.06	0.14	0.23	0.28	0.09	0.18	0.51	0.07	0.02	0.004	186	31	40	6.8	3.91	2.04	39.85	19.92	39
4/13/2022	58.16	41.84	0.51	0.06	0.13	0.24	0.29	0.09	0.21	0.55	0.08	0.02	0.004	116	28	38	6.6	4.7	3.1	38.74	19.37	37.6
4/15/2022	56.02	43.98	0.55	0.07	0.17	0.27	0.33	0.11	0.22	0.57	0.07	0.03	0.01	179	34	48	7.8	3.75	3.75	40.23	20.12	36.3
4/18/2022	61.34	38.66	0.49	0.07	0.17	0.25	0.3	0.1	0.15	0.41	0.07	0.02	0.004	174	28	46	7.5	4.26	0.21	38.45	19.23	39.2
4/20/2022	60.67	39.33	0.49	0.07	0.16	0.24	0.29	0.09	0.15	0.44	0.07	0.02	0.004	127	27	41	7.4	3.78	3.48	35.85	17.93	36.5
4/22/2022	63.12	36.88	0.47	0.07	0.16	0.24	0.28	0.09	0.16	0.47	0.07	0.01	0.004	139	28	41	7.2	1.9	2.54	34.34	17.17	36.7
4/25/2022	68.84	31.16	0.43	0.07	0.16	0.28	0.34	0.08	0.16	0.44	0.08	0.02	0.003	163	26	36	7.7	1.06	3.28	27.88	13.94	32.2
4/27/2022	60.08	39.92	0.51	0.08	0.17	0.28	0.33	0.1	0.24	0.62	0.08	0.03	0.01	125	49	43	7.6	1.05	4.04	35.88	17.94	35.4
4/29/2022	59.69	40.31	0.51	0.08	0.19	0.31	0.37	0.11	0.2	0.47	0.08	0.02	0.01	208	33	45	7.3	0.77	2.48	37.83	18.92	37
5/2/2022	61.48	38.52	0.49	0.08	0.18	0.27	0.32	0.1	0.16	0.45	0.07	0.02	0.004	191	27	41	7.3	0.93	3.41	35.11	17.56	36.2
5/4/2022	63.5	36.5	0.46	0.07	0.16	0.24	0.29	0.09	0.12	0.35	0.07	0.01	0.004	101	24	39	7.2	0.86	1.83	34.67	17.33	37.4
5/6/2022	64.55	35.45	0.45	0.07	0.17	0.26	0.31	0.09	0.13	0.37	0.07	0.02	0.01	95	24	39	7.5	2.35	2.72	32.73	16.37	36.1
5/9/2022	62.05	37.95	0.45	0.07	0.16	0.3	0.36	0.09	0.19	0.44	0.08	0.02	0.004	156	26	36	7.6	1.68	2.23	35.72	17.86	39.9
5/11/2022	61.9	38.1	0.5	0.08	0.18	0.28	0.34	0.09	0.16	0.4	0.08	0.02	0.01	118	28	38	7.7	3.84	0.41	37.69	18.84	38
5/13/2022	63.73	36.27	0.52	0.07	0.17	0.31	0.37	0.1	0.19	0.49	0.08	0.03	0.01	141	30	38	7.1	3.91	3.23	33.04	16.52	32.1
5/17/2022	64.89	35.11	0.52	0.07	0.17	0.3	0.36	0.09	0.14	0.36	0.08	0.01	0.004	93	26	37	8	3.11	2.84	32.27	16.14	31.3
5/19/2022	62.92	37.08	0.49	0.09	0.2	0.32	0.38	0.1	0.18	0.47	0.09	0.02	0.01	110	30	41	7	4.6	1.71	35.37	17.68	36.4
5/24/2022	58.57	41.43	0.53	0.1	0.23	0.29	0.34	0.13	0.17	0.46	0.07	0.01	0.004	116	32	148	7.5	1.55	0.98	40.45	20.23	37.8
5/26/2022	59.8	40.2	0.52	0.1	0.23	0.27	0.33	0.1	0.16	0.45	0.06	0.02	0.01	134	32	51	8	1.25	0.93	39.27	19.63	37.6
5/31/2022	61.58	38.42	0.52	0.08	0.19	0.28	0.34	0.11	0.18	0.62	0.08	0.02	0.01	122	34	42	7.9	1.44	2.07	36.35	18.18	35
6/2/6022	62.88	37.12	0.52	0.07	0.16	0.26	0.31	0.08	0.12	0.35	0.07	0.01	0.004	111	26	36	8.3	2.98	1.77	35.35	17.67	34
AVERAGE	61.23472	38.76528	0.495833	0.07	0.161389	0.2630556	0.315	0.094722	0.17583333	0.49	0.071944	0.019167	0.006278	130.3056	28.3333333	43.75	7.519444	3.254444444	1.972778	36.7925	18.39694	37.10833
ERROR	0.453009	0.453009	0.005092	0.00182574	0.004181	0.0043973	0.00511	0.001759	0.0060208	0.015625	0.001183	0.001082	0.000503	5.214726	0.78275054	3.035079	0.069444	0.259965335	0.187898	0.483516447	0.241807	0.381192

Appendix 3: PRECOMPOST data collected at Fessenden Farm, King Ferry, NY. Error is standard error

Date	Moisture	Solids	Total N	Phosphoru	Phosphate	Potassium	Potash	Sulfur	Magnesiun	Calcium	Sodium	Iron	Aluminum	Copper	Manganese	Zinc	pH	;oluble Salt	Ash	rganic Matt	Total C	C:N
3/4/2022	61.83	38.17	0.52	0.08	0.18	0.28	0.34	0.09	0.18	0.55	0.07	0.02	0.004	79	29	107	7.8	3.46	1.05	37.12	18.56	36.00
3/7/2022	60.93	39.07	0.55	0.08	0.18	0.3	0.37	0.09	0.16	0.48	0.07	0.02	0.004	84	29	43	7.9	1.49	0.66	38.41	19.2	34.6
3/10/2022	60.18	39.82	0.56	0.08	0.18	0.26	0.31	0.12	0.19	0.56	0.07	0.05	0.004	102	28	44	7.9	2.51	1.15	38.67	19.34	34.4
3/14/2022	61.92	38.08	0.56	0.08	0.19	0.28	0.34	0.1	0.19	0.58	0.07	0.02	0.004	55	29	45	8	2.51	0.01	38.07	19.04	33.8
3/16/2022	57.76	42.24	0.61	0.08	0.17	0.3	0.36	0.1	0.22	0.67	0.08	0.02	0.004	114	32	44	7.8	2.24	2.1	40.14	20.07	33
3/17/2022	58.49	41.51	0.56	0.07	0.16	0.28	0.33	0.09	0.13	0.41	0.07	0.03	0.004	93	276	41	8.1	3.06	1.24	40.27	20.14	35.9
3/21/2022	57.57	42.43	0.6	0.08	0.18	0.31	0.37	0.1	0.18	0.56	0.08	0.02	0.004	151	31	48	8.2	3.79	1.39	41.04	20.52	34.3
3/23/2022	59.59	40.41	0.56	0.07	0.16	0.27	0.32	0.09	0.17	0.46	0.07	0.02	0.004	120	27	42	8	2.9	1.29	39.12	19.56	35.1
3/25/2022	59.56	40.44	0.58	0.07	0.16	0.26	0.31	0.09	0.19	0.47	0.07	0.02	0.004	145	26	51	7.6	2.48	1.21	39.23	19.62	33.9
3/28/2022	63.78	36.22	0.55	0.07	0.15	0.27	0.32	0.09	0.15	0.43	0.07	0.02	0.004	139.27	27	40	7.5	2.46	0.46	35.76	17.88	32.3
3/30/2022	59.44	40.56	0.57	0.08	0.19	0.29	0.35	0.1	0.15	0.47	0.07	0.02	0.004	101	33	46	6.6	4.64	1	39.56	19.78	34.6
4/1/2022	56.62	43.38	0.56	0.07	0.16	0.26	0.32	0.1	0.18	0.49	0.07	0.02	0.004	144	27	43	7.9	2.48	1.31	42.07	21.03	37.3
4/4/2022	54.23	45.77	0.61	0.08	0.18	0.31	0.37	0.11	0.19	0.6	0.08	0.02	0.005	135	33	55	8.1	2.03	1.51	44.26	22.13	36.1
4/6/2022	54.73	45.27	0.62	0.07	0.17	0.28	0.34	0.1	0.19	0.56	0.08	0.02	0.005	137	33	47	7.9	2.36	1.42	43.85	21.92	35.4
4/8/2022	55.09	44.91	0.63	0.07	0.15	0.26	0.31	0.11	0.22	0.57	0.08	0.02	0.004	145	34	45	7.9	2.21	0.74	44.17	22.09	35.1
4/11/2022	58.75	41.25	0.53	0.07	0.15	0.22	0.27	0.09	0.2	0.53	0.07	0.01	0.004	134	29	43	7.8	2.94	1.53	39.72	19.86	37.6
4/13/2022	57.67	42.33	0.58	0.07	0.16	0.25	0.3	0.1	0.17	0.56	0.07	0.03	0.004	130	31	44	7.7	3.02	1.03	41.3	20.65	35.9
4/15/2022	57.59	42.41	0.59	0.09	0.2	0.28	0.34	0.11	0.2	0.55	0.08	0.02	0.01	113	35	52	7.6	3.39	3	39.41	19.7	33.2
4/18/2022	57.07	42.93	0.61	0.09	0.2	0.29	0.35	0.11	0.2	0.55	0.08	0.03	0.004	148	35	49	7.5	3.24	3.14	39.79	19.89	32.9
4/20/2022	55.98	44.02	0.61	0.09	0.21	0.29	0.35	0.11	0.2	0.52	0.08	0.02	0.004	180	35	49	7.5	2.8	2.96	41.06	20.53	33.6
4/22/2022	57.22	42.78	0.59	0.09	0.21	0.27	0.32	0.11	0.18	0.57	0.08	0.02	0.004	170	34	48	8.1	0.99	5.13	37.65	18.82	31.9
4/25/2022	60.46	39.54	0.53	0.08	0.19	0.26	0.31	0.09	0.17	0.49	0.08	0.02	0.004	124	31	45	8.2	1.08	4.71	34.83	17.42	32.9
4/27/2022	60.25	39.75	0.54	0.09	0.2	0.28	0.33	0.1	0.17	0.47	0.08	0.02	0.004	122	32	43	8.2	1.08	4.25	35.5	17.75	32.8
4/29/2022	60.82	39.18	0.54	0.09	0.22	0.29	0.34	0.11	0.16	0.43	0.08	0.02	0.004	145	31	47	8	3.62	2.34	36.84	18.42	33.8
5/2/2022	60.55	39.45	0.55	0.09	0.2	0.32	0.39	0.1	0.19	0.48	0.1	0.02	0.004	163	33	42	8	0.42	1.97	37.48	18.74	33.9
5/4/2022	58.78	41.22	0.58	0.09	0.21	0.31	0.38	0.11	0.17	0.41	0.08	0.02	0.004	154	31	43	8.1	0.76	1.85	39.37	19.68	34.4
5/6/2022	61.2	38.8	0.54	0.09	0.2	0.3	0.36	0.1	0.18	0.48	0.09	0.02	0.01	131	30	42	7.9	2.93	0.54	38.26	19.13	35.5
5/9/2022	60.57	39.43	0.51	0.09	0.21	0.27	0.33	0.1	0.13	0.38	0.07	0.02	0.01	162	28	41	7.9	3.16	0.91	38.52	19.26	37.9
5/11/2022	61.26	38.74	0.52	0.09	0.2	0.29	0.35	0.1	0.18	0.51	0.07	0.02	0.01	141	30	42	7.9	3.6	0.55	38.19	19.09	37.1
5/13/2022	58.9	41.1	0.55	0.09	0.21	0.3	0.36	0.1	0.18	0.49	0.08	0.02	0.004	123	31	42	7.9	2.35	0.67	40.43	20.22	36.4
5/17/2022	57.6	42.4	0.57	0.1	0.23	0.31	0.38	0.11	0.17	0.45	0.08	0.02	0.004	136	33	49	8	2.04	1.09	41.31	20.66	36.4
5/19/2022	61.04	38.96	0.6	0.11	0.24	0.32	0.39	0.12	0.19	0.48	0.09	0.02	0.004	147	34	48	7.6	2.6	0.6	38.36	19.18	31.8
5/24/2022	55.45	44.55	0.62	0.12	0.27	0.33	0.39	0.12	0.2	0.53	0.08	0.02	0.004	187	37	57	7.8	1.02	1.65	42.9	21.45	34.4
5/26/2022	54.17	45.83	0.62	0.12	0.27	0.32	0.38	0.11	0.2	0.49	0.07	0.02	0.005	126	37	55	8.2	1.49	1.33	44.5	22.25	36
5/31/2022	58.01	41.99	0.57	0.08	0.18	0.22	0.27	0.09	0.13	0.34	0.06	0.02	0.004	222	24	41	8	1.23	3.01	38.98	19.49	34.1
6/2/6022	61.74	38.26	0.52	0.05	0.12	0.25	0.3	0.05	0.1	0.4	0.07	0.004	0.004	128	46	26	8.2	2.43	0.93	37.33	18.67	35.6
AVERAGE	58.8	41.2	0.569722	0.083611	0.19	0.282778	0.340278	0.100556	0.176667	0.499167	0.076111	0.020944	0.00475	134.1742	38.36111	46.91667	7.869444	2.411389	1.659167	39.54083	19.77056	34.71944
ERROR	0.400348	0.400348	0.005599	0.002362	0.005345	0.004375	0.005278	0.002106	0.004272	0.011411	0.001277	0.0011	0.000317	5.216251	6.821203	1.93685	0.050051	0.160577	0.200672	0.404847	0.202385	0.266632

Appendix 4: COMPOST data collected at Fessenden Farm, King Ferry, NY. Error is standard error

Report Number
F22158-6511
Account Number
63570

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To: NEWTRIENT LLC - SIG GRANT
11510 LAURIE DR
WHEATFIELD, IN 46392-7364

For: FESSENDEN DAIRY

Attn: MARK STOERMAN

Sample ID: PRE-COMPOST (SOLID)
Lab Number: 45328

Date Sampled: 6/6/2022
Date Received: 6/7/2022
Date Reported: 6/22/2022

Page: 1 of 6

COMPOST ANALYSIS

Analysis	Unit	Analysis Result	Dry Basis Result	Analysis Method
Moisture @ 70 C	%	61.70		TMECC 03.09-A
Solids	%	38.30		TMECC 03.09-A
Total Nitrogen (N)	%	0.53	1.39	TMECC 04.02-D
Phosphorus (P)	%	0.09	0.23	TMECC 04.03-A
Phosphate (P_2O_5)	%	0.20	0.53	TMECC 04.03-A
Potassium (K)	%	0.31	0.82	TMECC 04.04-A
Potash (K_2O)	%	0.38	0.98	TMECC 04.04-A
Magnesium (Mg)	%	0.18	0.47	TMECC 04.05-MG
Calcium (Ca)	%	0.46	1.20	TMECC 04.05-CA
Arsenic	mg/kg	0.049	0.127	US EPA SW846-6020
Cadmium	mg/kg	0.033	0.085	US EPA SW846-6020
Chromium	mg/kg	0.45	1.17	US EPA SW846-6020
Copper	mg/kg	156	407	US EPA SW846-6010C
Mercury	mg/kg	< 0.008	< 0.020	US EPA SW846-6020
Molybdenum	mg/kg	0.40	1.04	US EPA SW846-6020

TMECC - Test Methods for the Examination of Composting and Compost (TMECC), The U.S. Composting Council.

-COMPOST

Report Approved By: [signature] Approval Date: 6/22/2022
David Henry - Agronomist / Technical Services - CCA

Report Number
F22158-6511
Account Number
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COMPOST ANALYSIS

Analysis	Unit	Analysis Result	Dry Basis Result	Analysis Method
Nickel	mg/kg	0.53	1.38	US EPA SW846-6020
Lead	mg/kg	0.105	0.275	US EPA SW846-6020
Selenium	mg/kg	1.24	3.24	US EPA SW846-6020
Zinc	mg/kg	40	105	US EPA SW846-6010C
503 Metals PASS/FAIL	pass/fail		PASS	EPA 503 Metal Limits
pH	-	7.9		TMECC 04.11-A
Soluble Salts	dS/m	3.59		TMECC 04.10-A
Fecal Coliform/MPN	MPN/g dry		4180	SM(20th)-9221E TMECC
Pathogen Reduction - PASS/FAIL	pass/fail		FAIL	40 CFR 503 Class A Compost
Ash @ 550 C	%	0.87	2.26	TMECC 03.02-B
Organic Matter (LOI @ 550 C)	%	37.43	97.74	TMECC 05.07-A
Total Organic Carbon (C)	%	18.72	48.87	TMECC 04.01-A
Carbon:Nitrogen Ratio (C:N)	-	35.2:1	35.2:1	TMECC 05.02-A
Foreign Material	%		0.00	TMECC 03.08-A
Germination - Emergence	%	93		TMECC 05.05-A

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COMPOST ANALYSIS

Analysis	Unit	Analysis Result	Dry Basis Result	Analysis Method
Germination - Vigor	%	96		TMECC 05.05-A
Ave Ht of Seedlings in Control	centimeters	10.9		TMECC 05.05-A
Ave Ht of Seedlings in Compost	centimeters	12.3		TMECC 05.05-A
Respiration - CO2-C/g TS	mg CO2-C / g TS/Day		17.9	TMECC 05.08-B
Respiration - CO2-C/g OM	mg CO2-C / g OM/Day		3.2	TMECC 05.08-B
Compost Stability Index	-		Moderately Unstable	TMECC 05.08
Passing U.S. 3/8-inch Sieve	%		100.00	TMECC 02.02-B
Retained on U.S. 2-inch Sieve	%		0.00	TMECC 02.02-B
Retained on U.S. 1-inch Sieve	%		0.00	TMECC 02.02-B
Retained on U.S. 5/8-inch Sieve	%		0.00	TMECC 02.02-B
Retained on U.S. 3/8-inch Sieve	%		0.00	TMECC 02.02-B
Retained on U.S. 1/4-inch Sieve	%		1.36	TMECC 02.02-B
Retained on U.S. 5/32-inch	%		5.97	TMECC 02.02-B

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COMPOST ANALYSIS

Analysis	Unit	Analysis Result	Dry Basis Result	Analysis Method
Moisture @ 70 C	%	58.31		TMECC 03.09-A
Solids	%	41.69		TMECC 03.09-A
Total Nitrogen (N)	%	0.56	1.35	TMECC 04.02-D
Phosphorus (P)	%	0.11	0.27	TMECC 04.03-A
Phosphate (P_2O_5)	%	0.26	0.62	TMECC 04.03-A
Potassium (K)	%	0.28	0.68	TMECC 04.04-A
Potash (K_2O)	%	0.34	0.82	TMECC 04.04-A
Magnesium (Mg)	%	0.17	0.41	TMECC 04.05-MG
Calcium (Ca)	%	0.46	1.10	TMECC 04.05-CA
Arsenic	mg/kg	0.079	0.189	US EPA SW846-6020
Cadmium	mg/kg	0.026	0.063	US EPA SW846-6020
Chromium	mg/kg	0.253	0.606	US EPA SW846-6020
Copper	mg/kg	123	294	US EPA SW846-6010C
Mercury	mg/kg	< 0.008	< 0.020	US EPA SW846-6020
Molybdenum	mg/kg	0.43	1.02	US EPA SW846-6020

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COMPOST ANALYSIS

Analysis	Unit	Analysis Result	Dry Basis Result	Analysis Method
Nickel	mg/kg	0.76	1.82	US EPA SW846-6020
Lead	mg/kg	0.105	0.251	US EPA SW846-6020
Selenium	mg/kg	0.70	1.67	US EPA SW846-6020
Zinc	mg/kg	44	106	US EPA SW846-6010C
503 Metals PASS/FAIL	pass/fail		PASS	EPA 503 Metal Limits
pH	-	8.2		TMECC 04.11-A
Soluble Salts	dS/m	2.40		TMECC 04.10-A
Fecal Coliform/MPN	MPN/g dry		< 2	SM(20th)-9221E TMECC
Pathogen Reduction - PASS/FAIL	pass/fail		PASS	40 CFR 503 Class A Compost
Ash @ 550 C	%	0.73	1.74	TMECC 03.02-B
Organic Matter (LOI @ 550 C)	%	40.96	98.26	TMECC 05.07-A
Total Organic Carbon (C)	%	20.48	49.13	TMECC 04.01-A
Carbon:Nitrogen Ratio (C:N)	-	36.4:1	36.4:1	TMECC 05.02-A
Foreign Material	%		0.00	TMECC 03.08-A
Germination - Emergence	%	93		TMECC 05.05-A

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Analysis	Unit	Analysis Result	Dry Basis Result	Analysis Method
Germination - Vigor	%	94		TMECC 05.05-A
Ave Ht of Seedlings in Control	centimeters	10.9		TMECC 05.05-A
Ave Ht of Seedlings in Compost	centimeters	12.9		TMECC 05.05-A
Respiration - CO2-C/g TS	mg CO2-C / g TS/Day		5.1	TMECC 05.08-B
Respiration - CO2-C/g OM	mg CO2-C / g OM/Day		1.2	TMECC 05.08-B
Compost Stability Index	-		Stable	TMECC 05.08
Passing U.S. 3/8-inch Sieve	%		100.00	TMECC 02.02-B
Retained on U.S. 2-inch Sieve	%		0.00	TMECC 02.02-B
Retained on U.S. 1-inch Sieve	%		0.00	TMECC 02.02-B
Retained on U.S. 5/8-inch Sieve	%		0.00	TMECC 02.02-B
Retained on U.S. 3/8-inch Sieve	%		0.00	TMECC 02.02-B
Retained on U.S. 1/4-inch Sieve	%		1.28	TMECC 02.02-B
Retained on U.S. 5/32-inch	%		2.33	TMECC 02.02-B

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