

Making Money from Manure

How do we get there?

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BIOFILTRO REVITALIZE WATER

Situation in California

- Low milk prices have led to hundreds of dairies exiting the industry
 - Need to use manure resource to generate revenue or reduce operating costs
 - Environmental management must consider economic feasibility
 - Go beyond digesters to address N concerns and dairies where digesters are not feasible
- California has ambitious environmental protection goals accompanied in some cases by stringent regulations and/or incentive programs
 - Reduce manure methane by 40 percent from 2013 levels by 2030
 - Maintain groundwater to drinking water protection goals of 10 ppm or less N
 - Achieve federal health standards for ozone and pm 2.5
- Monitoring shows elevated nitrates in groundwater where manure is applied
- Dairies/cattle contribute approximately half the state's methane emissions
- On average, manure N supply > demand by crops grown on CA dairies



Why We Have a Surplus of Nitrogen

- Some dairies have insufficient cropland or infrastructure to manage all the nutrients generated by their cattle
- Determining excess manure N at the dairy-farm scale presents technical challenges
- Exporting manure N presents technical/economic challenges, especially for manure stored in liquid form.
- Raw manure market potential limited due to concerns about food safety, weed seeds
- Compost market not fully developed
 - potential not well understood
 - regulatory/infrastructure barriers
 - competition from diversion of organics from landfills



How can we take advantage of this opportunity?

- Advances in and adoption of new technologies, combined with market development and where needed, addressing regulatory barriers, could turn excess manure into a valuable product for export off dairies
 - Create products that are valued by other farmers or industries
 - Export or transform excess manure N safely and cost-effectively
- Some strategies may provide the opportunity for multiple positive outcomes
 - Reduce methane, other air emissions and achieve whole-farm nutrient balance
- What are we trying to do?
 - Improve environmental outcomes and reduce liabilities for the industry and individual farmers in a cost-effective and/or profitable manner.
 - Improve the environmental and economic bottom line
 - Reestablish the natural sustainable nutrient cycle



The Ideal Manure Treatment System







- ✓ EFFICIENT ODOR CONTROL
- ✓ EFFICIENT CONTROL OF NUTRIENTS (CLEAN WATER)
- ✓ IMPROVE FLY CONTROL
- ✓ ABILITY TO CONTROL PATHOGENS & WEED SEEDS
- ✓ REDUCED AIR EMISSIONS (CLEAN AIR)
 - GHG (METHANE & NO₂) AMMONIA (NH₄)

- HYDROGEN SULFIDE (H₂S) - NO_X - VOCs

- ✓ RETURN ON CAPITAL THROUGH BY-PRODUCTS
 - FERTILIZER & SOIL AMMENDMENTS CREDITS
 - ENERGY CONSTRUCTION MATERIALS
- ✓ EASE OF OPERATION / LOW OPERATING COSTS

How can we take advantage of this opportunity?

- What are we trying to do?
- Examples of others who are already doing it
 - Fertical
 - Midwestern BioAg
 - Anuvia





http://www.fertikal.be/en/process-distribution

Fertikal is a worldwide player in the organic fertilizer market.

Fertikal processes Flemish (Belgian) and Dutch manure into composted soil conditioner and granulated organic fertilizer for agricultural and horticultural markets.

Fertikal's offices and production are located in the Port of Antwerp.

The production plant has been completely modernized in 2014 and is one of the largest in Europe.







FertiSOIL is an organic soil conditioner that plays a major role in the supply of stable organic material. It is essential for good soil structure and optimal soil activity. In addition to a high percentage of stable organic material, FertiSOIL contains the most important (NPK) nutrients and several trace elements, serving as a "must" for a healthy soil.



FertiHUM organic soll Conditioner NPK 2-2-2 - Mix 1 00

FertiHUM is an organic soil conditioner that plays a major role in the supply of stable organic material. It is essential for good soil structure and optimal soil activity. In addition to a high percentage of stable organic material, FertiHUM contains the most important (NPK) nutrients and trace elements. The ingredients used for this product are carefully selected by Fertikal. It is a true "activator" for your soil and all types of life within it.

FertiPURE 100% Organic Fertilizer NPK 4-3-3

FertiPURE is an organic fertilizer used for a range of different crops. In addition to the major nutrients such as nitrogen, phosphorus and potassium (NPK), FertiPURE contains a high percentage of organic material and important trace elements such as Fe, Mn, B, Mo, Zn and Cu.



PERTIPURE

FertiLUX Organo-mineral FertIlizer NPK 8-3-3

FertiLUX is a series of organo-mineral fertilizers that combine the advantages of organic and mineral fertilizers in one product. Thanks to the addition of mineral fertilizers, Fertikal is able to fit standard organic NPK formulas to the customer's specific requirements. In this way, each fertilizer can be tailored to the requirements of a crop, soil and climate.



FertiGOLD Organic Fertilizer NPK 6-3-3

FertiGOLD is a series of organic fertilizers used as base fertilizer for a range of different crops. In addition to providing primary nutrients such as nitrogen, phosphorus and potassium (NPK). FertiGOLD contains a high percentage of organic material and some very important trace elements such as Fe, Mn, B, Mo, Zn and Cu. FERTIGOLD

Degulation No.





FertiKING 100% Organic Fertilizer NPK 4-3-3

FertiKING is the "king" of our universal organic fertilizers. In addition to the major nutrients such as nitrogen, phosphorus and potassium (NPK), FertiKING contains a high percentage of organic material, as well as important trace elements such as Fe, Mn, B, Mo, Zn and Cu.



BERTIKIN

PROCESS & DISTRIBUTION

COLLECTION RAW MATERIALS IN THE REGION

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GERTIKAL[®]

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Prairies Edge Dairies Key Manure Technology Areas Creating New Revenue Opportunities From Manure



Sand Bedding Recovery with 85% recovery rate

Digester

- 3 X 300 ft. AD cells
- Creates gas and digestate for nutrient recovery

Gas Upgrading

- Cleans 60%
 CH₄ to 98%
- Pipeline quality
- Fuels CNG fleet and sold to utility

CNG Fleet

- 2 CNG fueling stations
- 42 trucks = saving 1.5M gal diesel
- 53 loads of milk delivered per day

Nutrient Recovery

- Optimizing fiber recovery
- Nutrients as 25%
 cake
- Focus on phosphorus
- Low nutrient tea
 water for irrigation

Renewable Fertilizer

- 4 specialty products
- Granular for ease of application
- Utilizes cake from nutrient recovery
- Sales nationwide













June 2017: Expanding the Value Chain – Fertilizer Production

The First Commercial Fertilizer Plant in the World Based Entirely on Manure Based Products

Innovative Partnership between Prairies Edge and Midwestern Bio Ag focuses on NPK cake as feedstock for commercial fertilizer plant

- 85,000 ft² facility for turnkey fertilizer manufacturing
- Production capacity of 65,000 tons of fertilizer each year
- 96% dry matter custom blended fertilizer *TerraNu*

















TerraNu Nutrient Technology

The Next Generation of Plant Nutrition













TerraNu Ignite™

TerraNu MicroPack™

TerraNu Calcium™





sustainability defined: Closing the Loop





Anuvia Manufacturing Process



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- What are we trying to do?
- Examples of others who are already doing it
 - Fertical
 - Midwestern BioAg
 - Anuvia
- Documented innovation, options and resources for California
 - Ruihong Zhang PhD, UC Davis Professor, ASABE Fellow, Chief Technology Advisor and Inventor, CleanWorld (2002 – Present)
 - Sustainable Conservation Compost Report (May 2017)
 - BioFiltro Fanelli Dairy, Hilmar, CA; Royal Dairy, Royal City, WA
 - California Dairy Research Foundation Manure & Manure-Based Products (Q4 2019)





Opportunities for Animal Manure Treatment for Biofuel, Bioenergy and Biofertilizer Production

- High energy and nutrient contents
- Consistent production year round







11.5 million dry tons of dairy manure per year





INSIDE: WILL CONGRESS PASS & RENEWABLE ENERGY MANDATE?

Powerful Pellets Renewed Interest in Bovine Biomass









MSNBS News,3/2007 House of the future? How about a manure mix Researchers turn cow pies into fiber for





rld's largest cow, Salem Sue, stands guard e dairy town of New Salem in North Dakota. eal-life counterparts - the United States' 100 cattle - burp enough methane to contribute al warming, but their manure can be used to te green electricity.



Dried manure, shown at left, is processed into building materials such as particleboard, center, and extruded lumber, right, at Michigan State University in East Lansing, Mich.



BioFertilizers from Dairy Manure

- Custom design biofertilizers products according to plant needs
 - Nutrients
 - Microbes
 - Pathogen free

Pelletized Solid





Liquid Fertilizer

ustainab







Tomato Fertigated with Liquid Digestate

Pelletized Biofertilizer Produced from Anaerobically Digested Dairy Manure



| | Dairy Digestate Concentrate TKN |
|----------------------------------|--|
| | |
| Dried solids (non pelletized) | 3.91% |
| Pelleted solids | 3.21% |





Removal Rates Total Kjeldahl Nitrogen

Total Phosphorous

85 - 95% 80 - 90%

Royal Dairy Receives 2018 U.S. Outstanding Dairy Farm Sustainability Award



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