ENGINEERING CONCEPTS
Chemical Engineering Solutions

Dear Sirs:

It is a pleasure to offer this proposal for your review. This process can be installed on any liquid manure system and has operated under severe weather conditions. This process works best with the more concentrated wastes, and encourages the producers to use as little water that dilutes the manure as possible. I trust that my proposal meets your selection criteria.

- An operational prototype is installed and working on a farm in Minnesota. Engineering Concepts and the Minnesota Department of Agriculture funded the project. This unit was built as a cooperative project of the University of Minnesota and Engineering Concepts. The University of Minnesota Department of Biosystems and Agricultural Engineering has conducted the evaluations of energy use, and reduction in odor for the system.

- Financial assistance is available. Last year, EQIP granted funds to make theUniversity of Minnesota Project a permanent installation because of the favorable environmental impact for the soil, air, and water. H2S emissions have been reduced from ppm levels to ppb levels. Ammonia emissions have been reduced by 70%.

- This is an economical process for the livestock producers (less than $4.00 per 1000 lbs of livestock). The effluent provides revenue for the farmer, and pays out the capital andoperating costs.

My associates and I can deliver these systems and expect them to operate as a fine piece of industrial equipment. Systems will be provided on a turnkey basis. As the technologyprovider, I can deliver the system on schedule for the price based on a firm bid, valid for 30 days.

I am looking forward to working with you. If you have any questions, please don’t hesitate to call.

Sincerely,
John Petering

Professional Engineer PE-018833-E (PA)

PROPOSAL FOR WASTE TREATMENT TECHNOLOGY

Executive Summary

A proven manure treatment system is proposed which effectively reduces the odor, enhances the fertilizer value, and increases the marketability of the manure produced by swine animals. The pre-manufactured and assembled unit is packaged for easy installation on a producer's site. The operational unit is durable and has low operational requirements. The treated material is much lower in biochemical oxygen demand and the nutrients phosphorous and nitrogen are less likely to be lost to the environment. The system provides beneficial return to the operator of the system in reduced odors in the building and to neighbors in the surrounding countryside. The treated manure is a much more acceptable material for transport and application to cropland and is therefore more of an asset to the operation. The low odor, low viscosity effluent can be used directly on more sensitive crops and golf courses. Added processing and recycling as barn water may reduce the need for transport to cropland. A full-scale swine treatment system using this new technology has been installed and operated on a nursery barn in Beauford, Minnesota.

1.1 Company Information

JOHN PETERING is the sole proprietor of Engineering Concepts, a consulting design company with associates who can manufacture, and deliver proprietary on site turnkey chemical,biochemical, and minerals processing plants for industry and agriculture.

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- Dennis Ward 148 Monks Avenue, Mankato, MN, 56001 507-625-4596
- Mark Kane, Judson Iron, Inc, Rt. 2 Box 187A, Lake Crystal, MN, 56055 507-387-3194
- Mid-States Mechanical, Inc., St. Hwy 169S., Mankato, MN, 56001 507-388-1572
- Wheeler Tank Manufacturing, Inc.4001 N. Fourth Ave.
  P.O. Box 85338,Sioux Falls, South Dakota, 57118-5338 800-888-9526

1.2 Proposed Technologies

Figure 1 Technologies Flow-Chart

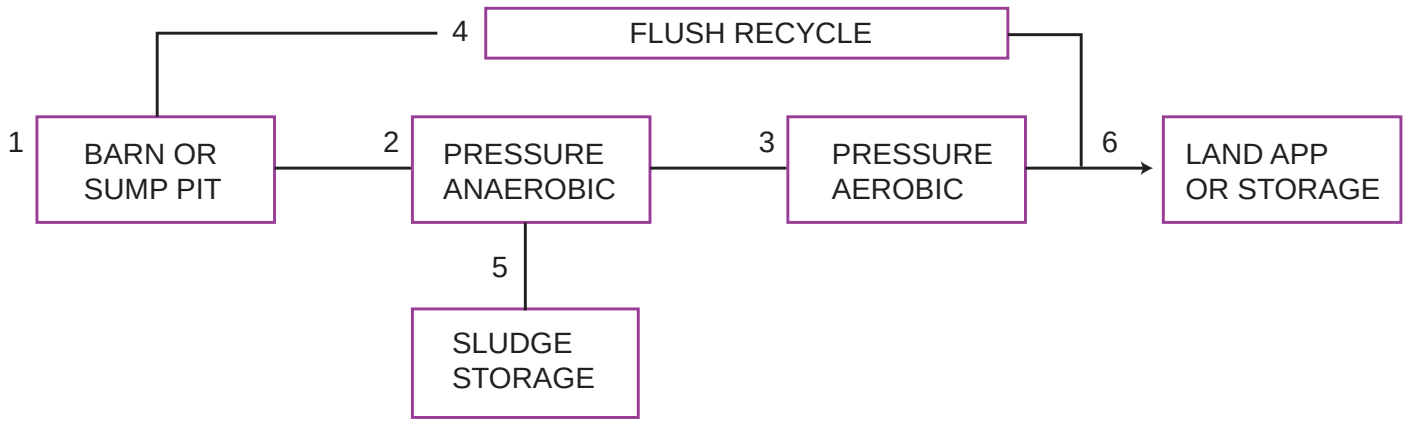

Table I Mass flow 500 S.E.

M LB/DAY

POINT	1	2	3	4	5	6
Q	44.900	140.600	139.600	95.800	12.0000	31.8100
BOD5	3.594	5.396	2.128	1.801	0.2251	0.1026
MLSS	3.631	16.893	15.796	13.262	1.657	0.8771
N	0.285					
P	0.202					
K	0.216					

1.2.1 Treatment system description

A full- scale swine manure treatment system using TOAST™ has been installed and operated on a nursery barn in Beauford, Minnesota. Judson Iron, Inc., of Judson, MN and Mid-States Mechanical, Inc, of Mankato MN accomplished the fabrication of the pre-built skid mounted unit. Wheeler Tank of Sioux Falls is proposed as the Reactor Manufacturer. The Nation Soil Conservation Service and Dennis Ward have provided EQIP funds to improve the equipment for long-term use.

Recently patented, this ***Tertiary Oxygen Activated Sludge Treatment***, TOAST™, system pressurizes undiluted fecal wastes from confinement feedlots. The manure is anaerobically treated with active microorganisms to force the microbes to selectively remove the soluble phosphorus from the wastewater. Periodic settling removes the grit and fiber particles as a low odor, low viscosity sludge. This primary treatment discharge flows into a holding tank, and easily removed for application. The high oxygen pressure aerobic portion intensely mixes air and mixed liquor volatile suspended solids, (MLVSS). High oxygen transfer efficiency reduces O2 transport energy costs five—fold. This removes soluble Biological Oxygen Demand (BOD) from the water and hydrolyzes a significant portion of the solid BOD. Solids are reduced by over 50%. Over 70% of the soluble BOD are converted to microbes and CO2. The CO2 neutralizes the manure to a pH 7-8. The heavy phase (20%) is neither slimy nor sticky. Over half of the NH3 nitrogen and most (90%) of the phosphorus are in the heavy phase. The freshly deodorized liquid is depressurized and returned to the flush water system.

1.2.2 End-Products Description and Use

The soluble BOD is converted to bio -mass and CO_2. The CO_2 neutralizes the manure to a pH 7-8. The heavy phase (25%) is neither slimly nor sticky. Over half of the NH3 nitrogen and most(90%) of the phosphorus are in the heavy phase.

The light phase low viscosity liquid (75%) can be used as barn cleaning or drinking water to flush the barn. Dilution water or additives to prevent scaling is not required. The primary use of the product is as a crop fertilizer. In the next five years, it may have a future application as a feed for other animals or re-fed as a water / protein nutrient saving over $ 5.00 US per hog and eliminating the need to spread on the ground by 50 to 90 percent. Since is has been tested in the AURI experiment to be salmonella negative, it may be possibly used to wet the swine to reduce dander. It can be applied directly to grass or crops, stored in covered or uncovered pits, or sold to neighboring farmers as a deodorant for their manure pits. 5 to l0 farms can be deodorized by this method, without affecting permit limits. This can recover the cost in five years.Barn flushing rates of 5 to 60 sow—equivalents per (gallon per minute) are practical. This prototype (Beauford site) test unit treats 300 sow equivalents with 5- l 0 gallons per minute daily. No lagoon is needed for biological treatment. In the next five years, it may have a future application as a feed for other animals. It can also be re-fed as a water /protein nutrient saving $5.00 US per hog. This eliminates the need to spread on the ground by 50-90%. Since is has been tested in the AURI experiment to be salmonella negative, it may be possibly used to wet the swine to reduce dander and dust.

1.2.3 Environmental Advantage of Technology

Air

Odors from the manure are greatly abated Hydrogen Sulfide emissions are reduced by over 99.7%. Although over 80% of the ammonia vapors are retained in the liquid, ammonia vapor emissions are reduced by 50 to 80%. This defers a hazard to the ozone layer. The work area would be OSHA safe for animals and workers. Explosive gases like methane ar not generated in the process or subsequently in storage. The need to ventilate at the floor level is eliminated. The work area would be safe for animals and workers. Explosive gases like methane are not generated in the process. Abominable odors never re-occur.

Soil

The solids contain facultative microbes. The conversion of the volatile ammonia to nitrate occurs quickly for use as a crop nutrient. The balance of the Nitrogen value and most of the phosphorus value is in the biomass deterring seepage from out of the root area.

Water

Microbes capture the nutrients, so they stay in the soil and protect the ground water. Less run off prevents algae growth in surface water. The low viscosity of the liquid and buffered ammonia makes spreading easier, and much less offensive, so spreading directly onto grass or field is possible.

• *No lagoon will ever be used again as a flow channel. This eliminates a cause of fish kills.*

1.3 Site Requirements—Size of livestock operation

The minimum size for now is for 200 (s.e.), or 6000 nursery pigs. An optimum size is based on the economy of scale, but limited to the electrical power capacity on the farm motors larger than 25 HP limit most farms. A 500-sow equivalent (s.e.) farm, farrow to finish, would be economic, but more savings are expected for a 1000 (s.e.) unit farm. A 10,000 (s.e.) feedlot would require 3 reactors. If only odor reduction with no exported manure is desired, these units have 3 to 5 times the odor reducing effect. So the three- reactor system could easily handle 50,000 s. e.

Space Requirements

A 1,000 sow unit would require a concrete pad, 12' x 15', to hold a 12' diameter. x 40' high tank. Footings are required for an 10' x 20' machine skid, and 12' x 20' area for other tanks. Access to the site by a large crane is required.

Utility Requirements

The 300 s.e. site uses 5 kW. Slightly more kW per s.e. would be needed for a higher quality of treatment. A 1,000. sow operation requires 25 to 50 kW, preferably at 480 volts 3 phase power. Higher voltage lowers motor costs and power losses.

Retrofit requirements

Electrical upgrades may be required A concrete slab is required for the skid-mounted control unit and tanks. No lagoon will ever be used again as a flow channel. Deep pit -liquid is pumped into the system, and returned to the pit. Multi-pit systems—liquid is channeled through the pits to a catch basin, and returned Open ditch or slotted flush barns. The supply pump treats flush water from the catch basin.

Staffing Requirements

The system is automated. A daily inspection of the machine is useful, but the system is Programmable Logic Controller (PLC) automated, and shuts down safely. No more than l/2 hour per day is required to check on the unit. The system uses municipal treatment plant pumps and equipment. A 1- week training seminar by the vendors~would be adequate. The operator should be literate, mechanically inclined, and trainable.

1.4 Technology Evaluation

The PLC monitors the power usage and the temperature rise. Periodic N, P, and K analysis of the upper and lower phases would indicate performance. Initial Odor tests also would be useful. To determine the acceptability of the effluent for marketing, samples should be presented to potential buyers. Demonstration plots at several locations may be useful, i.e. spreading on Golf Courses hickory nut trees, truck farming or hardwood forests.

1.5 Economic Evaluation

Figure 2. Economic Review of Technology—Cost/ Revenue

	200 A. U.	500 S. E.	1000 S. E.
Initial investment, Site, construction, Start up 20 yr. life	$80,000 USD	$150,000 USD	$195,000 USD
Land area	900 sq ft.		
Construction time			
Operating costs Labor, etc.	1500	2000	3000
Income from increased pork production	10% wt. increase 20% sold@10 cent/gal	10% wt. increase 20% sold@10 cent/gal	10%wt. increase 20% sold@10 cent/gal
Deodorant Production			
Power usage	6 kW	12 kW	22 kW

Payment: *50% with order, 25% on delivery, 25% on completion. This proposal is valid for 30 days. F. O. B. jobsite.*

1.6 Required Time

Final design and preparation of a quote for installed system	4 weeks
Construction in shop	12-18 weeks
Construction on farm	3 weeks
Start-up system / fine-tuning	4 weeks

1.7 References

Philip R. Goodrich, Professor, Department of Biosystems and Agricultural Engineering, University of Minnesota, 1390 Eckles Ave., St. Paul, MN, 551058 612-635-4215

Jack Johnson AURI P. O. Box 251,Waseca, MN, 56093-0251 507-835-8990

Dennis Ward 148 Monks Avenue, Mankato, MN, 56001 507-625-4596

Paul & Caroline Mostertman, 3387 Tolmie Road, Yarrow, B.C., Canada 604-823-4862