ON-FARM DAIRY MANURE COMPOSTING

PRODUCING A VALUE-ADDED PRODUCT

F.D. Daoust
WHAT WE DO?

- **Consulting:**
  - Small to medium scale composting
  - Planning, training, implementation, follow up
  - Support different aspects like permits requirements, grants and other issues

- **Equipment distributor:**
  - AGF-BROME env. products
  - PATZ (mixer and conveyor)
  - Other related products
PRESENTATION HANDOUT

- Project description
- Farm information
- Issues with liquid manure management
- The composting process at the farm
- Challenges
- Project cost
- Benefits for the farm and the environments
- Next step?
PROJECT DESCRIPTION

F.D. Daoust
PROJECT DESCRIPTION

- Initial objective:
  - Recycling composted manure as bedding
  - Remove excess nutrient from farm

- Modified objective:
  - Compost production
  - Sell the compost
ISSUES WITH LIQUID MANURE MANAGEMENT

Source: Eco Watch (http://ecowatch.com/2012/poor-farming-practices-foul-drinking-water-at-the-source/)
ISSUES WITH LIQUID MANURE MANAGEMENT

- Quebec milk industries:
  - Most important provinces (milk production, 2011)
    - 6218 milk producers (49.28% of Canada)
    - 38.28% of Canadians dairy fat productions
  - Less farm but bigger farm

![Milk production is shifting to large dairy farms](chart.png)

ISSUES WITH LIQUID MANURE MANAGEMENT

- Manure nutrient content:
  - Stream and lake eutrophication (runoff, erosion)
    - Phosphorus as an indicator
    - Regulation on phosphorus (env. tracer)

Source: Baltic Deal (http://www.balticdeal.eu/measure/manure-standards-and-analysis/)
ISSUES WITH LIQUID MANURE MANAGEMENT

- GHG:
  - Anaerobic condition
  - O.M. Mixed with water
  - $CH_4$, $N_2O$, $CO_2$

ISSUES WITH LIQUID MANURE MANAGEMENT

- Odors:
  - Odors potential for a long period

- Cost:
  - Tendance to increases:
    - Transportation and land application
    - Land are more expensive
    - Manure storage (new farm)
    - Dependency to manure receptors
ISSUES WITH LIQUID MANURE MANAGEMENT

THE COMPOSTING PROCESS
THE COMPOSTING PROCESS

Operation plan for slurry manure solid/liquid separation and composting

Dairy water

Lane

Processing pit (slurry manure)

Composted recycled bedding

Storage

Liquids

Separator

Temporary solids storage

Tractor

Taures and calving cows (solid manure)

Silage trailer

Feeder

Composter

Compost/bedding storage (force aeration?)

Optional recirculation

Conveyor

Conveyor
THE COMPOSTING PROCESS

PURCHASED EQUIPMENT:
- Manure separator (used) + pump
- 2 Conveyors
- Rotary drum composter (6’ x 32’, 28.8 m³)
- Hand-held thermometer
THE COMPOSTING PROCESS

- EQUIPMENT FROM THE FARM:
  - Building
  - Silage trailer
  - Blower, drainage pipes, timer
  - Scale and oven (humidity testing)
THE COMPOSTING PROCESS

- **Initial mix:**
  - Recipe 1: Solid manure + used bedding (step 1) (%H = 65-70%)
  - Recipe 2: Solid manure + used bedding + separated manure (step 2)

- **Introduction to composter:**
  - Target: ~ 10 m$^3$/day

- **In-vessel composting process (drum):**
  - Retention time: ~ 2.2 days
  - Achievement of 55°C or higher
  - Forced aeration
  - More than 100 rotation/day

<table>
<thead>
<tr>
<th>PARAMETER</th>
<th>RESULT</th>
<th>UNIT</th>
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<tbody>
<tr>
<td>Bulk Density</td>
<td>682</td>
<td>kg/m$^3$</td>
</tr>
<tr>
<td>Nitrogen (Total)</td>
<td>1.28</td>
<td>%</td>
</tr>
<tr>
<td>Phosphorus (Total)</td>
<td>0.28</td>
<td>%</td>
</tr>
<tr>
<td>Potassium (Total)</td>
<td>1.26</td>
<td>%</td>
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<tr>
<td>Sodium</td>
<td>0.41</td>
<td>%</td>
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<tr>
<td>Organic Matter</td>
<td>81.70</td>
<td>%</td>
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<tr>
<td>Total Ash</td>
<td>18.30</td>
<td>%</td>
</tr>
<tr>
<td>Moisture</td>
<td>79.98</td>
<td>%</td>
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<tr>
<td>C:N Ratio</td>
<td>36.1</td>
<td>%</td>
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<tr>
<td>Total Organic Carbon</td>
<td>45.39</td>
<td>%</td>
</tr>
<tr>
<td>pH (Saturated)</td>
<td>6.75</td>
<td>---</td>
</tr>
<tr>
<td>Total Solids</td>
<td>20.02</td>
<td>%</td>
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</tbody>
</table>

Comment:
THE COMPOSTING PROCESS

- After Drum composting:
  - Humidity at 58-60%
  - Further composting or drying
    - Composting with force aeration for 10 days (for sales)
    - OR
    - Drying (For recirculation)
THE COMPOSTING PROCESS

- **Drying:**
  - 58-62% humidity to 35% in 12 days
  - Forced aeration with low cfm (5 min. On/15 min. Off)
  - Temperature up to 80°C
  - Solvita result (after re-humudifying at 60%): Maturity index = 6
COMPOST USE

- Compost will be sold to a local landscaper:
  - Needs for around 2600 m$^3$/year (3652 yard$^3$)
  - Need a stabilized compost
  - Can pay up to 14$/m^3$ (18$/ yard^3$) or 28$/tons
CHALLENGES
CHALLENGES

- Keeping the farmer to follow us

- Drying manure in winter time:
  - Moisture removal capacity of cold air
  - Induce air flow vs forced aeration???

Source: [http://hyperphysics.phy-astr.gsu.edu/hbase/kinetic/relhum.html](http://hyperphysics.phy-astr.gsu.edu/hbase/kinetic/relhum.html)
CHALLENGES

- Manure characteristic to produce bedding:
  - Not working with solid manure:
  - To much moisture in separated manure:
    - Need to add dry materials ≠ viable
    - Need a more efficient separator (25 to 45K$)
  - Avoiding woodchips in initial recipe
PROJECT COST
PROJECT COST

- Composting equipment:
  - Rotary drum, conveyor, automation, separator:
  - Wood, fan and piping, lab testing, etc.
  - Total: 125 000$

- Already own:
  - Building and slab, tractor
  - Silage wagon
  - Oven and scale
PROJECT COST

Possible revenue:
- Compost production: 2190 m$^3$ (1100 ton)
  - Estimated vol. Reduction = 40%
- Possible sale cost: 24 to 28$/ton (bulk)

Potential revenue (from landscaper):
- 1100 ton/year * 28$/ton = 30 800$/year

Potential revenue (average bulk price, 2002):
- 1100 ton/year * 24$/ton$^1$ = 26 400$/year

System is paid in 4 years

$^1$AQIC, 2002
PROJECT COST

- Other cost:
  - Operation: ~ 30-45 min./day
  - Electricity: Very low consumption
  - Maintenance

- Avoided cost:
  - Manure handling and spreading
  - Manure transportation

AQIC, 2002
PROJECT COST

- Other benefits:
  - Odor reduction for composted manure
    - But some odor related to composting
  - Phosphorus issues
  - GHG reduction

AQIC, 2002
CARBON OFFSET?

Can we get $$$ for reducing GHG?:

- Rough estimate: Offset of 260 tons eqCO$_2$/years
- Voluntary credit: 4$ to 5$/tons eqCO$_2$
- Compensating credit: Start at 8$/tons eqCO$_2$
- Minimum needed to start: 5000 tons eqCO$_2$
- We need 20 similar farms

**Possible revenue/farm:**

- 260 tons eqCO$_2$/years * 5$/t = 1300$/year

AQIC, 2002
NEXT STEP?

- Improve separator performance
- Try to use dried compost for taures and calving cows
- Bagging compost?
- Co-Composting?

AQIC, 2002
QUESTIONS?

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Thanks!

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