INNOVATIONS IN COMBINING AD AND COMPOSTING: PRODUCTION OF BIOGAS, HIGH QUALITY COMPOST AND RECYCLABLE FRACTIONS FROM MIXED WASTE
WHY LOOK AT MIXED WASTE?

• Some communities find separate collection unaffordable
• Even with SSO collection, remaining organics in mixed MSW represent the largest potential for increasing diversion and recycling
• If we can produce a clean compost and recyclable fractions from mixed waste, then a significant increase in diversion: ZERO WASTE (>90% diversion) becomes attainable
• But so far mixed waste compost has been of low quality

HOW DO WE GO ABOUT IT?
Innovative Approach to Separation and Recovery

MUNICIPAL SOLID WASTE

100%

DRY SORTING

63%

DRANCO DIGESTION

51%

SORDISEP WET SEPARATION

34%

ORGANIC FRACTION

AEROBIC STABILIZATION

COMPOST (28%)

RDF (28%)

METALS (5%)

REFUSE (4%)

BIOGAS (12%)

INERTS (5%)

LIGHT FRACTION (12%)

EVAPORATION (5%)

DRY MATTER LOSS (1%)
THE DRANCO AD TECHNOLOGY

DRANCO DIGESTER

- Feeding tubes
- Gas storage
- Dosing screw
- Extraction
- Feeding pump
ADVANTAGES of DRANCO AD for OFMSW

• Less intensive pre-treatment
  – Maximizes organics to AD
  – Soiled paper allowed in the feedstock, even beneficial
  – No water added
  – Smaller reject fraction

• Robust Digester Design
  – Highly tolerant of contamination – light and heavy
  – No scum formation, no settling in the tank
  – Intensive and reliable digestion
  – High flexibility (total solids content in digester 15 – 40%)
  – No mixing equipment inside the digester

• Avoids or minimizes wastewater production
BIODEGRADABILITY OF PAPER

Paper: Twice to 5x the biogas yield per ton versus yield of MSW-organics.
DRANCO DIGESTATE: TRULY UNIQUE

DIGESTATE
DRANCO DIGESTATE: TRULY UNIQUE

DIGESTATE BIRTHDAY CAKE
SORDISEP:
Wet separation after dry anaerobic digestion
Digestate still contains all non-digestible fractions of OFMSW digester feedstock
LIGHT FRACTION
SORDISEP – END PRODUCTS

CENTRIFUGE CAKE
COMPOST
SORDISEP INTEGRATION IN BOURG-EN-BRESSE PLANT (FRANCE)
FEEDSTOCK: BLACK BIN MIXED WASTE
SOR DIS EP – PRODUCT FLOW

**SORTING (MRF)**
- Mixed waste (MSW)

**ANAEROBIC DIGESTION**
- Organic fraction of MSW
- Digestate after DRANCO digestion

**BIOGAS PRODUCTION**

**SOR DIS EP**
- Washed inerts
- Combustible light fraction
- Clean compost

SORTING (MRF)

Mixed waste (MSW)

Organic fraction of MSW

Digestate after DRANCO digestion

BIOGAS PRODUCTION

Washed inerts

Combustible light fraction

Clean compost
• ‘Soft’ Pretreatment with long residence rotating drums, producing to <2”
• DRANCO AD
• SORDISEP technology
• Aerobic composting of Sordisep organic centrifuge cake with some yard waste
• Capacity:
  – 72,700 sh t/y mixed waste
  – 8,200 t/y green waste
  – Capacity AD: 44,000 t/y
• Volume digester: 115,000 ft³
• Start-up: end of 2015
• ‘Industrial operation’ since May 1st, 2016
• Production of:
  – Compost: 23,000 sh t compost/y
  – Biogas: 4,800 scf/ton
  – Electricity: > 10 000 000 kWh/y, 1.2MW rate
LONG RESIDENCE ROTATING DRUMS
(2 drums of 40x4.25m or 125x14ft)
DRANCO Digester (44,000 sh t)
Dilution of digestate and screening over 3mm
Wet separation of light and heavy fraction
CENTRIFUGES: Remove remaining organics <3 mm from process water and produce process water
SORDISEP INPUT

SORDISEP INPUT = DRANCO DIGESTATE

- Particle size: <50 mm (screened over 2 inches in pretreatment)
- Overall composition
  - TS = 31%
  - VS = 50%
  - pH = 8.5
- Composition on TS content
  - Fine organic fraction : 48-52%
  - Light materials >3 mm : 35-40%
  - Heavy materials >3 mm : 12-14%
OUTPUT: LIGHT FRACTION (FIBERS, PLASTICS, …)

- Particle size: <50 mm in 2 dimensions
  (after pretreatment and DRANCO AD)

- Composition
  - light plastics: 25-35%
  - hard plastics: 5-20%
  - textiles/fibers: 25-45%
  - Other (fraction <5 mm incl.): 15-25%

- Calorific value:
  - Lower combustion value: 5,100 BTU/lb
  - Higher combustion value: 6,000 BTU/lb (brown coal 8,000 BTU/lb)
**OUTPUT: HEAVY FRACTION (INERTS, …)**

- Particle size: <50 mm (after pretreatment and DRANCO AD)
- Composition (on TS)
  - Glass: 70-85%
  - Stones: 5-20%
  - Others: 5-15%
- Quality meets the clients’ demands (leachate test to determine soluble matter and TOC)
ORGANIC FRACTION (= CENTRIFUGE CAKE)

- Composition
  - TS = 37-41%
  - VS = +/- 50%
- Addition of yard/green waste: 8,200 tpy as bulking agent
- Mix is sent to aerobic composting
## ANALYSIS: HEAVY METALS IN SORDISEP COMPOST (1)

Results of press cake & compost in comparison to standards:

<table>
<thead>
<tr>
<th>Metals</th>
<th>Norm US EPA mg/kg TS</th>
<th>Norm France mg/kg TS</th>
<th>Compost BeB mg/kg TS</th>
<th>Norm Ontario CLASS AA</th>
<th>Norm Canada CLASS A</th>
<th>Norm Canada CLASS B</th>
</tr>
</thead>
<tbody>
<tr>
<td>Arsenic</td>
<td>75</td>
<td>18</td>
<td>2.4</td>
<td>13</td>
<td>13</td>
<td>75</td>
</tr>
<tr>
<td>Cadmium</td>
<td>85</td>
<td>3</td>
<td>0.8</td>
<td>3</td>
<td>3</td>
<td>20</td>
</tr>
<tr>
<td>Chromium</td>
<td>3,000</td>
<td>120</td>
<td>67</td>
<td>210</td>
<td>210</td>
<td>1060</td>
</tr>
<tr>
<td>Copper</td>
<td>4,300</td>
<td>300</td>
<td>126</td>
<td>100</td>
<td>400</td>
<td>760</td>
</tr>
<tr>
<td>Lead</td>
<td>840</td>
<td>180</td>
<td>66</td>
<td>150</td>
<td>150</td>
<td>500</td>
</tr>
<tr>
<td>Mercury</td>
<td>57</td>
<td>2</td>
<td>0.2</td>
<td>0.8</td>
<td>0.8</td>
<td>5</td>
</tr>
<tr>
<td>Nickel</td>
<td>420</td>
<td>60</td>
<td>57</td>
<td>62</td>
<td>62</td>
<td>180</td>
</tr>
<tr>
<td>Zinc</td>
<td>7,500</td>
<td>600</td>
<td>402</td>
<td>500</td>
<td>700</td>
<td>1850</td>
</tr>
</tbody>
</table>
## RESULTS OF SORDISEP COMPOST IN COMPARISON TO SSO & GREEN WASTE COMPOST

<table>
<thead>
<tr>
<th>Metals</th>
<th>Norm US EPA mg/kg TS</th>
<th>Norm France mg/kg TS</th>
<th>Compost Mixed waste mg/kg TS</th>
<th>Compost SSO Brecht mg/kg TS</th>
<th>Green waste compost Brecht mg/kg TS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Arsenic</td>
<td>75</td>
<td>18</td>
<td>1,6</td>
<td>3,4</td>
<td>1,7</td>
</tr>
<tr>
<td>Cadmium</td>
<td>85</td>
<td>3</td>
<td>1,4</td>
<td>0,9</td>
<td>1,3</td>
</tr>
<tr>
<td>Chromium</td>
<td>3,000</td>
<td>120</td>
<td>39</td>
<td>21,0</td>
<td>35,1</td>
</tr>
<tr>
<td>Copper</td>
<td>4,300</td>
<td>300</td>
<td>151,2</td>
<td>64,4</td>
<td>143,9</td>
</tr>
<tr>
<td>Lead</td>
<td>840</td>
<td>180</td>
<td>64,6</td>
<td>73,7</td>
<td>65,4</td>
</tr>
<tr>
<td>Mercury</td>
<td>57</td>
<td>2</td>
<td>0,2</td>
<td>0,0</td>
<td>0,1</td>
</tr>
<tr>
<td>Nickel</td>
<td>420</td>
<td>60</td>
<td>36,7</td>
<td>13,8</td>
<td>46,3</td>
</tr>
<tr>
<td>Zinc</td>
<td>7,500</td>
<td>600</td>
<td>534,2</td>
<td>215,3</td>
<td>531,9</td>
</tr>
</tbody>
</table>
Results of press cake & compost in comparison to standards

=> Digested organics for compost production are screened over 3mm

California norm Jan 1, 2018:

Physical contaminants > 4mm: \( \leq 0.5\% \) on TS \( \rightarrow \) <5 g/kg TS
and <20% of these contaminants are film plastics \( \rightarrow \) <1 g/kg TS

=> SO STANDARD WILL CERTAINLY BE MET!
ANALYSIS: PCBs & PAHs

Results of compost from Sordisep in comparison to green waste compost and SSO-compost

- Sum PCB’s = <0.07 mg/kg TS
  - => Far below the Hawaii limit of 1.1 mg/kg TS
- All measured MAH’s: non-detectable
- Most measured PAH’s: non-detectable

Exceptions:

<table>
<thead>
<tr>
<th></th>
<th>BEB-Compost mg/kg TS</th>
<th>SSO compost mg/kg TS</th>
<th>Green waste compost mg/kg TS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Benzoanthracene</td>
<td>0,14</td>
<td>0,22</td>
<td>0,25</td>
</tr>
<tr>
<td>Chrysene</td>
<td>&lt;0,3</td>
<td>0,32</td>
<td>0,39</td>
</tr>
<tr>
<td>Fenanthrene</td>
<td>0,46</td>
<td>0,56</td>
<td>1,1</td>
</tr>
<tr>
<td>Fluoranthene</td>
<td>0,4</td>
<td>0,62</td>
<td>1,3</td>
</tr>
</tbody>
</table>
ANALYSIS: PESTICIDES

Results of press cake & compost in comparison to standards

- Organochlorine pesticides: all far below the Hawaii limit*
  - DDD: < 0.0030 mg/kg TS (DOH limit: 2.4)
  - DDE: < 0.0020 mg/kg TS (DOH limit: 1.7)
  - DDT: < 0.0050 mg/kg TS (DOH limit: 2.4)
  - Dieldrin: < 0.010 mg/kg TS (DOH limit: 0.03)
  - Chlordane: < 0.0030 mg/kg TS (DOH limit: 15)

- Organophosphate pesticides: all far below the Hawaii limit*
  - Diazinon: < 0.02 mg/kg TS (DOH limit: 55)
  - Malathion: < 0.01 mg/kg TS (DOH limit: 1,200)

* There is no US-norm!!!
MINERAL OILS

Results of press cake & compost in comparison to standards

=> Mineral oils are present but *petroleum based* mineral oils were absent

ALL CHEMICAL STANDARDS CAN BE MET

- Heavy metals
- PCB’s
- PAH’s
- Pesticides
- Petroleum based mineral oils
COMPOST CHARACTERISTICS BOURG-EN-BRESSE

- Digestate has been wetted to 5% solids (95% water) and is subsequently screened over a sieve of 3mm. The organics are recovered by centrifugation of the liquid containing the fine organics and composted.
- Compost **meets the future CA regulation** of less than 0.5% contamination of which less than 20% can be film plastics.
- Low heavy metals (similar to SSO) and other contamination way below standards (herbicides, PCB’s, PAH’S, petroleum based mineral oils)

CLEAN COMPOST PRODUCED
CLEAN RECYCLABLE FRACTIONS:

- Heavy fraction (glass, stones, …) is free of organics and plastics and can be recycled in road construction.
- The light fraction is free of glass and stones and has a high calorific value (6000 BTU/lb, similar to brown coal).

PRODUCTION OF A CLEAN COMPOST AND RECYCLABLE FRACTIONS OUT OF MIXED WASTE ORGANICS IS WASTE WELL WITHIN REACH …………………
SORDISEP IS A GIANT LEAP TOWARDS ZERO WASTE