Agricultural Plastics: An Alternative Fuel for the Portland Cement Industry

Presented to The Pesticide Stewardship Alliance

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KOOGLER & ASSOCIATES, INC.
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Discussion Topics

• Increased Use of Alternative Fuels
• Cement Industry Operations
• Environmental Regulation Implications
• The Potential for Agricultural Plastics
Global Alternative Fuel Initiatives

• Reasons
  – EU Carbon Trading
  – Fuel security: foreign fuels (demand of China and other developing countries)
  – Price stability: broad range of fuel sources, business impact of price stability
  – Local investment dollars (local fuels = local economic activities)
  – Conservation: re-use waste
  – Reduce landfilling of waste (hard to site new landfills)

• U.S. Renewable Portfolio Standard (RPS)
  – Potential for federal RPS
  – 28+ states with RPS’s currently, others proposed
  – Mandate for use of renewable fuels
  – Waste materials can be considered “renewable”

• Other state and local initiatives
Local Fuels: e.g., Florida

Reduced carbon footprint
Fuel diversity = price stability
Improve local economics

Solid Waste facilities

Coal Mining facilities
Global Initiatives:
Alternative Fuels for Cement Industry

<table>
<thead>
<tr>
<th>Country or region</th>
<th>% Substitution</th>
</tr>
</thead>
<tbody>
<tr>
<td>Netherlands</td>
<td>83</td>
</tr>
<tr>
<td>Switzerland</td>
<td>47.8</td>
</tr>
<tr>
<td>Austria</td>
<td>46</td>
</tr>
<tr>
<td>Norway</td>
<td>35</td>
</tr>
<tr>
<td>France</td>
<td>34.1</td>
</tr>
<tr>
<td>Belgium</td>
<td>30</td>
</tr>
<tr>
<td>Germany</td>
<td>42</td>
</tr>
<tr>
<td>Sweden</td>
<td>29</td>
</tr>
<tr>
<td>Luxembourg</td>
<td>25</td>
</tr>
<tr>
<td>Czech Republic</td>
<td>24</td>
</tr>
<tr>
<td>EU (prior to expansion in 2004)</td>
<td>12</td>
</tr>
<tr>
<td>Japan</td>
<td>10</td>
</tr>
<tr>
<td>United States</td>
<td>8</td>
</tr>
<tr>
<td>Australia</td>
<td>6</td>
</tr>
<tr>
<td>United Kingdom</td>
<td>6</td>
</tr>
</tbody>
</table>

Examples:
- Waste with Btu’s
  - Cannot landfill, must burn waste
- Cement kilns in Europe
- EU Carbon Credits for waste fuels

Targets: 50 to 70% by 2015
Limitations to Recycling All Waste

- EU Mandates: requires recycling and combustion (reduced landfilling)
- E.g., practical limit in Denmark is 42 percent recycling, 54 percent combustion

<table>
<thead>
<tr>
<th></th>
<th>US</th>
<th>Denmark</th>
</tr>
</thead>
<tbody>
<tr>
<td>Recycled</td>
<td>33%</td>
<td>42%</td>
</tr>
<tr>
<td>Landfill</td>
<td>54%</td>
<td></td>
</tr>
<tr>
<td>Combustion with Energy Recovery</td>
<td>13%</td>
<td>54%</td>
</tr>
</tbody>
</table>

Sources: E.P.A.; Eurostat
Landfill vs. Incineration

The majority of nonrecyclable waste in the United States is placed in landfills, and most of the rest is burned. Both processes can generate energy. A 2009 study suggests that burning is the superior option – even though many American waste-to-energy plants lag far behind state-of-the-art models in Europe in both cleanliness and efficiency.

Landfills that collect gas

ONE TON OF WASTE CAN CREATE ...

65 kWh of electricity

Plants that burn waste

590 kWh of electricity
# The Public Push: Waste Combustion versus Landfill Gas

## ONE TON OF WASTE CAN CREATE ...

| 65 kWh of electricity | 590 kWh of electricity |

## EMISSIONS FOR ONE MEGAWATT-HOUR OF ELECTRICITY

| 3.35 metric tons, carbon dioxide equivalent | 0.56 metric tons, carbon dioxide equivalent |
| 600 grams of sulfur oxides | 220 grams of sulfur oxides |
| 2,300 grams of nitrogen oxides | 1,450 grams of nitrogen oxides |

One metric ton is one million grams, or 1.1 short tons.

## ONE YEAR’S WORTH OF WASTE COULD GENERATE ...

| 9 million MWh of electricity ... | 80 million MWh of electricity ... |
| ... enough to power 800,000 homes for one year. | ... enough to power 7 million homes for one year. |

U.S. Cement Industry

102 plants in U.S. producing up to 100 millions tons of cement
## Energy Derived from Fuels Used in Cement Production (EPA)

<table>
<thead>
<tr>
<th>Fuel Type</th>
<th>Quantity Used in Cement Production</th>
<th>percent heat input</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coal</td>
<td>10 mm tons</td>
<td>64.05%</td>
</tr>
<tr>
<td>Petroleum Coke</td>
<td>2.6 mm tons</td>
<td>21.18%</td>
</tr>
<tr>
<td>Natural Gas</td>
<td>12.7 billion cu. ft.</td>
<td>3.66%</td>
</tr>
<tr>
<td>Middle Distillates</td>
<td>20.7 mm gallons</td>
<td>0.81%</td>
</tr>
<tr>
<td>Residual Oil</td>
<td>3.5 mm gallons</td>
<td>0.15%</td>
</tr>
<tr>
<td>Gasoline</td>
<td>1.5 mm gallons</td>
<td>0.05%</td>
</tr>
<tr>
<td>LPG</td>
<td>1.0 mm gallons</td>
<td>0.02%</td>
</tr>
<tr>
<td>Waste Oil</td>
<td>--</td>
<td>0.29%</td>
</tr>
<tr>
<td>Waste Solvents</td>
<td>--</td>
<td>3.97%</td>
</tr>
<tr>
<td>Tire Derived Fuel</td>
<td>--</td>
<td>3.57%</td>
</tr>
<tr>
<td>Other Solids</td>
<td>--</td>
<td>0.76%</td>
</tr>
<tr>
<td>Waste - Miscellaneous</td>
<td>--</td>
<td></td>
</tr>
</tbody>
</table>
Modern Cement Kilns: Efficient and Complete Combustion

Typical modern kiln

Kiln Temperature Zones

<table>
<thead>
<tr>
<th>Preheater</th>
<th>Calciner</th>
<th>Rotary Kiln</th>
<th>Cooler</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gas</td>
<td>Raw Materials Temperature</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Retention Time = 10 sec</td>
<td>= 3 sec</td>
<td>= 10 sec</td>
<td>= 1 sec</td>
</tr>
<tr>
<td>Retention Time = 1 min</td>
<td>= 30 min</td>
<td>= 30 min</td>
<td></td>
</tr>
</tbody>
</table>

Typical boiler
Fuel consumption

Per typical kiln:
50k to 100k ton/yr - coal
25 percent operation cost
Coal, $50 – 100/ton
$2.5M to $10M/yr/kiln
**Desired Waste Fuel Properties**

- High Btu; low: moisture, sulfur, chlorine, metals (Hg and Pb)
- Processed and sized for injection
- Typical materials:
  - Tires
  - Plastics (manufacturer spec. often available)
  - Roofing shingles
  - Paper/cardboard
  - Wood/biomass
  - Others: autofluff, animal manure, agricultural wastes, wastewater treatment sludge
Pros

• High energy content
  (50% higher than fossil)
• Low moisture, chlorine, and sulfur
• Low metals (Hg, Th, Pb, Cd, Cr)
• Long-term storage
• Minimal odors

• Minimal potential for spontaneous combustion
• Processed and sized for injection
• Contamination acceptable, e.g., soil and pesticides
Ag Plastics Fuels

**Cons**

- Undeveloped supply market
  - Standards are needed for all commodities (e.g., recycled paper market)
  - Material location, quantity, when available
  - Transportation and distribution system
  - Central collection locations
  - Cost Analyses

- Kiln Combustion system evaluation needed
- Environmental permitting
- Public perception
Ag Plastics Fuels

Environmental Regulations

**AAQS**

- EPA recently adopted new one-hour ambient air quality (health-based) standards for sulfur dioxide ($\text{SO}_2$) and nitrogen dioxide ($\text{NO}_2$) emissions

- Ag plastics fuels typically have lower $\text{SO}_2$ and $\text{NO}_2$ emissions than fossil fuels

- Replacement of fossil fuels with ag plastics fuels could help with compliance with new standards
Ag Plastics Fuels

Environmental Regulations

**Greenhouse Gas Emissions**

- GHGs emissions are now regulated under federal air construction permitting for stationary sources (called the PSD “Tailoring” Rule)

- The use of ag plastics fuels in lieu of fossil fuels could be considered to meet emission reduction requirements under this rule
Proposed CISWI Rule – potential roadblock!

- EPA has proposed a new definition of “solid waste” for purposes of federal air regulations
- EPA has also proposed air emission standards for commercial and industrial solid waste incineration (CISWI) facilities
- Final rules could be issued next week – or within the next few months
Ag Plastics Fuels

Proposed CISWI Rules

• “Solid waste” definition is key: if a secondary material, such as ag plastic, is considered “solid waste,” then the CISWI rule will apply

• Current proposal provides that a discarded material would not be a solid waste if it is:
  – considered a traditional fuel (e.g., clean woody biomass or on-specification used oil)
  – used by the generator of the material as a fuel or feedstock
  – used by a non-generator as a fuel or feedstock and the material
    • is processed (more than shredding) for improved fuel qualities
    • is a valuable commodity
    • has a significant heating value
    • has a similar composition and similar contaminants to conventional fuels
Proposed CISWI Rules
Legitimacy Test to show Ag Plastic is a “Fuel”

Flow Chart for Determining Whether Non-Hazardous Materials Used as Fuel in Combustion Units are Solid Waste

Material is Not a Waste

Is the Material a Traditional Fuel?

Has the Material Been Discarded in the First Instance (i.e., abandoned, disposed, thrown away)?

Secondary Material is a Waste unless Administrator has granted a non-waste determination

Is the Material Managed within the Control of the Generator?

Has the Material Been Sufficienly Processed?

Does the Material Satisfy the Legitimacy Criteria?

Is the material managed as a valuable commodity?

Does the material have a meaningful heating value?

Does the material contain contaminants at levels comparable to or lower than traditional fuels which the combustion unit is designed to burn?

Secondary Material is a Waste (Sham Recycled and therefore considered to be “disposed”)

Secondary Material is Not a Waste

NO TO ONE

YES TO ALL
Ag Plastics Fuels

State or Local Environmental Regulations may be required

• E.g., State solid waste processing permit could be needed if shredding or other processing occurs on-site
Air Emissions – Cement: Ag Plastics

- Pollutants of concern
  - **NOx**: same or reduced, mostly thermal NOx, NOx not dependent on fuel type
  - **SO2**: reduced, due to lower sulfur than coal
  - **CO**: same or lower, controlled by operator – air/fuel ratio
  - **VOC**: same or lower, higher volatility than coal
  - **PM**: particulate matter, fuel type not majority of PM source
  - **Metals (Hg and Pb)**: reduced, lower content than coal
  - **Dioxin/furan**: same or lower, not a function of fuel type
  - **HCl**: reduced, lower chlorine content than coal
  - **Pesticide and endocrine disruptors**: effectively thermal destruction
Potential for Cement Industry

• The demand is here for Ag plastics
  – 10% fuel replacement in U.S. cement = 500,000+ tons per year

• Need to define the supply

• Data sharing of suppliers is critical

• Commodity standards are needed
  – Supply categorization
  – Manifesting
  – Material analysis (e.g., max. Hg content)
  – Goal for permitting is to provide “reasonable assurance”
Turning agricultural plastics into a resource

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Questions? Thank you.