Waste to Energy – Update on the latest technology options for material preparations

By Eric Paulsen
Business Manager DKSH, Environmental Technology Solutions

Wasteminz, 22nd of October 2015
We link business partners and add value to businesses

We support our clients in marketing, selling and distributing products, provide after-sales services and market insight in new and existing markets.

We support our customers in getting the best raw materials, products and brands at the best price, and we provide them with knowledge and market insights.

Think Asia. Think DKSH.
…with a comprehensive, tailor-made portfolio of services

Market Expansion Services goes beyond offering individual services – it is about the integration of many different services to meet the needs of business partners.

Tailor-made, integrated service portfolio

Backflow of information from customers to clients enabled by fully integrated and centralized IT platform.
**DKSH is a successful market leader**

<table>
<thead>
<tr>
<th><strong>No. 1</strong></th>
<th><strong>5,500</strong></th>
<th><strong>13 million</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Market Expansion Services provider with a focus on Asia</td>
<td>clients</td>
<td>transactions per year</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>CHF 9.6 billion</strong></th>
<th><strong>&gt;10 years</strong></th>
<th><strong>735</strong></th>
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<tbody>
<tr>
<td>Net sales (2013)</td>
<td>&gt;3 countries</td>
<td>business locations</td>
</tr>
<tr>
<td>average client relationship 1)</td>
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<tr>
<th><strong>150</strong></th>
<th><strong>27,200</strong></th>
<th><strong>500,000</strong></th>
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<tbody>
<tr>
<td>years in Asia</td>
<td>employees</td>
<td>customers</td>
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</table>

1) Top 200 clients by net sales

*Think Asia. Think DKSH.*
...and a network of unique scope and depth

Europe and the Americas

<table>
<thead>
<tr>
<th>Denmark</th>
<th>France</th>
<th>Germany</th>
<th>Great Britain</th>
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<tr>
<th>Italy</th>
<th>Norway</th>
<th>Switzerland</th>
<th>USA</th>
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<tbody>
<tr>
<td>Brazil</td>
<td>China</td>
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Asia Pacific

<table>
<thead>
<tr>
<th>Australia</th>
<th>Brunei</th>
<th>Cambodia</th>
<th>China</th>
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<tbody>
<tr>
<td>Guam</td>
<td>Hong Kong</td>
<td>India</td>
<td>Indonesia</td>
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<th>Japan</th>
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<th>Laos</th>
<th>Macao</th>
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<td>Malaysia</td>
<td>Myanmar</td>
<td>New Zealand</td>
<td>Philippines</td>
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<td>Saipan</td>
<td>Singapore</td>
<td>Sri Lanka</td>
<td>Taiwan</td>
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<tr>
<td>Thailand</td>
<td>Vietnam</td>
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DKSH Environmental Technology Solutions focuses on proven technologies for resource recovery and recycling

- Size reduction
- Sensor based automatic sorting
- Compacting and baling
- Screening
- Wind shifting
- De-baling and bag opening
- Custom tailored engineering
- Automation and Energy solutions
# Resource Recovery Options

<table>
<thead>
<tr>
<th>SOURCE</th>
<th>RECOVERY OPTIONS</th>
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</thead>
<tbody>
<tr>
<td>Kerbside collection</td>
<td>- Recycleables and Waste to Energy =&gt; RDF</td>
</tr>
<tr>
<td>Commercial and Industrial Waste</td>
<td>- Recycleables and Waste to Energy =&gt; RDF</td>
</tr>
<tr>
<td>MSW</td>
<td>- Composting, Recycleables and Waste to Energy =&gt; RDF</td>
</tr>
<tr>
<td>Construction and Demolition</td>
<td>- Aggregates, timber, metals and waste to energy = RDF</td>
</tr>
<tr>
<td>Biomass</td>
<td>- Composting and <strong>Powerplant</strong></td>
</tr>
</tbody>
</table>

*Think Asia. Think DKSH.*
Waste to Energy Technologies

Direct Combustion
is the most commonly used technology for converting waste to heat and/or electrical energy. During direct combustion, waste or a fuel derived from waste is burnt in excess oxygen (from air) to produce heat or release the energy contained in the fuel. Excess oxygen/air means there is more air available than necessary for the combustion process.

+ Direct incineration of waste material
+ Well established technology
+ Clean technology with minimal emissions due to advanced treatment
+ Metal recovery from incineration slag possible
- No recovery of plastics, organics and other recyclables
- Relatively low net energy recovery due to lower calorific value and moisture
Gasification

is a process that converts organic or fossilised organic materials such as coal, at elevated temperatures and with controlled amounts of oxygen, into a syngas (see ‘Syngas’) compromising carbon monoxide, hydrogen, carbon dioxide, nitrogen, methane and other low molecular weight organic molecules.

+ Claimed higher net energy recovery than incineration
+ smaller foot prints possible
+ Well established for single source combustibles (wood chips, Bio-matter)
- Emerging technology with now some established projects for mixed material streams
- Usually less recovery of recyclables
Waste to Energy Technologies

Pyrolysis
is a thermo-chemical decomposition of organic material at elevated temperatures in the absence of oxygen. Pyrolysis typically occurs under pressure and at operating temperatures above 430°C and generates oils, tars and syngas.

+ Claimed higher net energy recovery than incineration
+ smaller foot prints possible
- Relatively unproven for mixed waste streams at current models
Waste to Energy Technologies

Refuse Derived Fuel (RDF)
is a fuel produced by processing waste typically by shredding (particle size reduction) and dehydrating (moisture removal) as well as removal of non-combustible materials such as inerts and metals.
There is no standard process for producing RDF, as the process depends on the type of material to be processed and the proposed end use of the fuel.

Solid Recovered Fuel (SRF)
is a fuel produced in the same manner as RDF but to a specific quality standard.
There are a number of specifications and publications referring to SRF in the European context (see also CEN/TC 343).

+ Can be used as alternative fuels in various process: Cement, Cogeneration, power generation, tradeable and open market
+ High level of recycling can be achieved based on commodity value of the fractions
+ High calorific value fractions give best energy recovery
+ Processing of waste does not require capital intensive WtE plants
+ Pre-sorting can allow organics recovery for composting instead of incineration
- Requires retrofit for existing systems to manage the different feed stock
Waste to Energy Technologies

Bio Fuel
is a fuel that is produced through contemporary biological processes, such as agriculture and anaerobic digestion, rather than a fuel produced by geological processes such as those involved in the formation of fossil fuels, such as coal and petroleum. Biofuels can be derived directly from plants, or indirectly from agricultural, commercial, domestic, and/or industrial wastes. Renewable biofuels generally involve contemporary carbon fixation, such as those that occur in plants or microalgae. Other renewable biofuels are made through the use or conversion of biomass. This biomass can be converted to convenient energy containing substances in three different ways: Thermal conversion, chemical conversion, and biochemical conversion. This biomass conversion can result in fuel in solid, liquid, or gas form. This new biomass can also be used directly for biofuels.

+ Can be used in many forms and traditional boiler systems with simple conversion
+ Closing the carbon cycle
+ Similar costs to fossil fuels- but typically have lower emissions
+ Easy to source
+ Wood chips and pellets are easily bulk handled
- Could foster mono-culture
- Could compete with food agriculture space

Think Asia. Think DKSH.
Waste to Energy in Germany

![Chart: Number of Selected Waste Management Facilities]

Source: Statistisches Bundesamt 2009

Think Asia. Think DKSH.
Waste to Energy in Germany

Recovery Rates of Main Waste Fractions (in Percent)

Source: Statistisches Bundesamt 2009
RDF / SRF production
More than 50% of the running costs in a power or cement plant is generated by the needed energy.

Coal costs ~ 80 - 120 Euro per ton. A small cement plant needs ~ 15 and a big power plant needs more than 400 t/hour.

Cement companies like Cemex, Dyckerhof, Heidelberger, Holcim or Lafarge are world wide operating companies.

Using RDF, if the quality is o.k., is much more profitable than burning coal or oil.

Any boiler that wants to use RDF has chemical specifications, depending on end product quality, lifetime of the boiler and pollution.

Currently west EU companies deliver RDF into a lot of other countries. Some local politicians took already the decision to produce this RDF in their own countries, like Poland, Mexico and Ukraine.

Huge potential in cement plants, estimation > 20mil tons per year.
Requirements for RDF

- production of a high-calorific fraction with low chlorine content (< 1%) from
  - Municipal solid waste
  - commercial and industrial waste
  - bulky waste
  - production waste
In PVC and PVDC contains between 5% und 59% chlorine. Tubes, toys, carpets, wallpapers, blisters, packaging materials and deco materials are typical examples for PVC.

All other plastic materials could contain chlorine in flame retardents, colours or to make it UV resistant.

Salt, NaCl and KaCl are in the organic fraction.

In the paper fraction, the biggest fraction in diff. waste streams we find ~ 0,2 – 0,3 % CI.

In glue, colours etc could also be a chlorine content, mostly very low.
Process steps for RDF and SRF Fuel Generation

1. Shredding – Crushing
2. Sizing – Screening
3. Metal removal
4. Windsifting / ballistic separation
5. PVC Removal
6. Secondary shredding
7. Baling and wrapping
Shredding and Crushing

HAAS Crushing

Weima shredding
Screening with Spaleck

Process: Material sizing to remove inerts
Wind sifting with Westeria

Process: Heavy light separation using air flow and drum separation

Purpose: Remove inerts and heavies that could destroy the secondary shredder
Ballistic Separators Stadler

Operating principle: The machine consists of a set of six paddles rotating offset against each other. The angle of the complete set of paddles can be adjusted to roll out heavies and 3D material

Purpose: Removal of heavy and rolling material
Recovery of Recycleables
PVC Removal with NIR - Tomra

Process: Detection and removal of PVC

Purpose: Controlling the Chloride content
Automatic Sorting of Plastics with NIR Technology from TITECH
Secondary Shredding Weima

Process: Shredding of material with single shaft shredder to final material size

Purpose: For many RDF / SRF applications, size needs to be between approximately 30-80 mm. Depending of off-take
Baling and Wrapping with Macpresse

Process: Baling and Wrapping of RDF / SRF

Purpose: Volume reduction for transport and containment of Fluff material
The Problem

• The incineration of Refuse Derived Fuel (RDF) with a high chlorine and water content leads to

  – Reduction of the energy content
  – Increased exhaust emissions
  – Damages by corrosion in the thermal waste treatment facilities
  – High maintenance costs
  – Downtime

• Therefore it is necessary to measure and check these critical values
RDF Quality Control with Tomra

Current Situation

**RDF Material**

Input material
Municipal solid waste
Commercial & Industrial waste

**Sampling of the input feed**

Laboratory analysis of these *Spot tests*

- Samples often not representative
- Analysis of only a very few gram
- High fluctuation of the results of measurements
- High time-lag
RDF Quality Control with Tomra

Differences of spot tests, examples Chlorine

3 Samples of one stream

Analyse 1

0.8%

Analyse 2

1.7%

Analyse 3

2.0%

Deviation min./max.  > 100 %
Tomra Solution – Online Analysis of the material stream

- Analysis in real-time
- Recording of large material streams (instead of spot tests)
- Optional averaging
- Easy integration into an existing process
- Prevention of maintenance time and downtime

Think Asia. Think DKSH.
Calculation of the parameters

Relevant data for calculation:
- mass per unit area
- fuel value
- conversion factors
Continuous monitoring in praxis

Example: Chlorine

![Graph showing chlorine concentration over time with a moving average line.]

- Mass percentage
- Time

Moving average over 5 minutes
Continuous monitoring in praxis

Example: Upper Heating value

Moving average over 5 minutes
Continuous monitoring in praxis

Example: Water content

Moving average over 5 minutes
TITECH analyses YOUR RDF Material ONLINE
Plant Example Stadler
Plant Examples Westeria
Plant Example – Westeria
Plant Video
Thank you for your attention.
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