Technologies and Management of Municipal Solid Waste in Thailand: Status Quo and Current Developments

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Integrated Resource Management in Asian Cities: the Urban Nexus
General Information

- Inhabitants: 69,122,234
- Population of Capital (2009): 7,025,000 (official figure)
- Population of BMR (2009): 12,177,000 (estimated)
- 76 Provinces
  - 1277 municipalities and
  - 6636 SAO’s in Thailand (Subdistrict Administrative Organizations or Thesaban)
Distribution of Authorities for MSW

Royal Thai Government

Central Government
- Formulate policies, guidelines, programs, regulations and standards

Regional Governments
- Coordinate related works between central and local governments

Local Governments
- Handle waste management within governed area
  - Implementing Unit

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### Generation of MSW

<table>
<thead>
<tr>
<th>Region</th>
<th>2005</th>
<th>2006</th>
<th>2007</th>
<th>2008</th>
<th>2009</th>
<th>2010</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bangkok</td>
<td>8,291</td>
<td>8,403</td>
<td>8,532</td>
<td>8,780</td>
<td>8,834</td>
<td>8,766</td>
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<tr>
<td>Special Zone Pattaya</td>
<td>12,635</td>
<td>12,912</td>
<td>13,600</td>
<td>14,915</td>
<td>16,368</td>
<td>16,620</td>
</tr>
<tr>
<td>Central and Eastern Region</td>
<td>5,499</td>
<td>5,619</td>
<td>5,780</td>
<td>5,258</td>
<td>5,830</td>
<td>5,918</td>
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<tr>
<td>Northern Region</td>
<td>2,148</td>
<td>2,195</td>
<td>2,346</td>
<td>2,931</td>
<td>3,255</td>
<td>3,315</td>
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<tr>
<td>North-Eastern Region</td>
<td>2,906</td>
<td>2,970</td>
<td>3,167</td>
<td>4,267</td>
<td>4,700</td>
<td>4,768</td>
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<tr>
<td>Southern Region</td>
<td>2,082</td>
<td>2,128</td>
<td>2,307</td>
<td>2,459</td>
<td>2,583</td>
<td>2,619</td>
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<tr>
<td>Outside Municipalities</td>
<td>18,295</td>
<td>18,697</td>
<td>18,200</td>
<td>17,369</td>
<td>16,208</td>
<td>16,146</td>
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<tr>
<td>Whole Thailand</td>
<td>39,221</td>
<td>40,012</td>
<td>40,332</td>
<td>41,064</td>
<td>41,410</td>
<td>41,532</td>
</tr>
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</table>

Pollution Control Department, Annual Report, 2011

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Thai MSW

- High amount of organics (>50%)
- Water content > 50%
- High amount of small plastic bags
- Little amount of recycling materials
- Calorific value low (3-4 MJ/kg)

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Improper Disposal
Municipal Solid Waste (MSW)

Tipping point: Officials inspect the main refuse dump on Koh Samet in Rayong, which has reached full capacity. The chief of Khao Laem Ya National Park, of which the tourist island is a part says that no more forest area can be earmarked for additional dump.
Collection Rate

![Bar chart showing the quantity of MSW (ton/day) for Bangkok, Inside Municipality, and Outside Municipality areas. The chart compares production and disposal.]
Waste Flow
Waste Flow

Transfer Station

Dump site / landfill
Waste Flow outside Bangkok

- Household
  - Waste Bin
    - Garbage Collection
      - OBOTO
        - Landfill Dump, MBT
          - Scavengers
    - Informal Collectors (Saleng)
      - Collecting Company
    - Illegal Dumping
      - Burning
    - Composting
      - Animal Feed
  - Recycling Quota
    - Recycling Company
      - Washing and Repacking Company
    - Government
      - Private and informal sector
    - Private and informal sector

Ai Hiramatsu et al., Waste Manag Res 2009; 27; 951
Wongpanich (Recycling Materials)

- Founded in 1974
- Over 400 branches in Thailand
- Buys recycling materials
- Located at good locations
- Franchising
Waste Treatment Technologies
MSW Treatment

- Landfill / open dumps
  - Number of operating sanitary landfills: 93
  - Number of landfills that never opened: 8
  - Number of landfills that have been closed: 6
  - Number of open dumps: 330 (official)

- Incinerators: 3
  - Phuket: 250 t/d currently extended to 850 t/d
  - Koh Samui: 150 t/d (only partially operational)
  - Lampang: 6 t/d
  - Bangkok 500 t/d (under construction)

- Integrated Waste Management: 3
Incinerators

Phuket

Koh Samui
Economic Models

- Government operated
- BOT (Build-Operate-Transfer)
  - Private investor
  - License from government for treatment of MSW
    - $x$ years (10-30), $y$ tons/day, $z$ Baht/t tipping fee
  - Private investor has to recover investment, o&m costs and profit from treatment process
Economic Models

Tipping Fee

Electricity
Recycling materials
Reduced disposal costs

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Income Distribution

Energy

Tipping Fee

High Income Countries
Europe, USA, Japan

Lower Income Countries
Thailand
Problems of MSW in Thailand

- Collection of waste on the country side is difficult
- Responsibility of waste management on Thesaban level leads to small amounts of waste
- No enforcement of regulations
- Tipping fee very low
- Landfills are almost full
- Resistance of the informal sector
Integrated Waste Management

100% Commingled Waste

Sorting System

Composting 50 - 60 %

Recycled materials 20 - 30 %

Leftover 10 - 20 %

Final Disposal < 5 %

Conversion to RDF

Power and Energy Utilization

Adder tariff
Problems for Automatic Sorting

- High water and organic matter content
- Bag-in-the-bag concept

- Small amounts of waste
- Road transport
- Low Tipping Fee
- Social Factors
Municipal Waste Management Center
Criteria for Successful Technology

- Can treat unsorted MSW
- Can cope with high moisture content of MSW
- Can utilize all components to generate electricity:
  - Biogas and RDF
- Can treat wide range of MSW compositions
- Environmentally friendly
- Economically feasible
MYT (Biodamp) Technology

- Mixed MSW Metal separation
- Mechanical pretreatment
- Paper, packaging
- BIODAMP®
- Biogenic drying
- Off-gas treatment
- Electric current
- Heat
- Co-generation
- Anaerobic digestion 2 days
- Aerobic waste water treatment 6 days
- Aerobic waste water treatment 8 days

~90 %

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Biodamp Pilotplant Petchaburi

BIODAMP® Pilot Plant Thailand

Company: WEHRLE Umwelt GmbH
Location: Petchaburi, Thailand
Input: 3 t/d Municipal Solid Waste
Year: 2010 – 2011
Waste with high organic contents
Water content ~ 50-60 %
Waste composition of the input material
Fresh waste in the DAMP®-mixer
Treated waste in the DAMP®-mixer
Dewatered output of the DAMP®-mixer
Water content ~ 35 %
Structure of the output material
Air-drying (rotting) of the output material
Key Figures of the dry output material RDF:

- Water content ~2 %
- Calorific value $H_u = 13,000 - 20,000$ kJ/kg
- Chlorine content 0.24 – 0.44 %
Clustering of Thesaban

Source: Pollution Control Department 2011
## Clustering (2)

<table>
<thead>
<tr>
<th>Cluster Size</th>
<th>Waste Load [t/day]</th>
<th>Number of Clusters</th>
<th>MoU Agreements</th>
</tr>
</thead>
<tbody>
<tr>
<td>Large Cluster</td>
<td>&gt; 500</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>Medium Cluster</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>M1</td>
<td>250 – 500</td>
<td>206</td>
<td>140</td>
</tr>
<tr>
<td>M2</td>
<td>100 – 250</td>
<td>26</td>
<td>18</td>
</tr>
<tr>
<td>M3</td>
<td>50 – 100</td>
<td>88</td>
<td>65</td>
</tr>
<tr>
<td></td>
<td>&lt; 50</td>
<td>92</td>
<td>57</td>
</tr>
<tr>
<td>Small Cluster</td>
<td>&lt; 50</td>
<td>301</td>
<td>207</td>
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</table>

<table>
<thead>
<tr>
<th>Cluster Size</th>
<th>Recommended Processes</th>
</tr>
</thead>
<tbody>
<tr>
<td>L</td>
<td>Sorting + Bio-conversion Process + Incineration + Landfill</td>
</tr>
<tr>
<td>M1</td>
<td>Sorting + Anaerobic Digestion + Gasification/Pyrolysis/Stoker Incineration + Landfill</td>
</tr>
<tr>
<td>M2</td>
<td>Sorting + Bio-conversion Process + Pyrolysis/ Gasification + Landfill</td>
</tr>
<tr>
<td>M3</td>
<td>Sorting + Bio-conversion Process + Pyrolysis/ Gasification + Landfill</td>
</tr>
<tr>
<td>S</td>
<td>Sorting + Bio-conversion Process + Landfill</td>
</tr>
</tbody>
</table>

Source: Pollution Control Department 2011

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Existing Clusters (2011)
Conclusion

- Most cities in Thailand face a “waste crisis”
- New landfills face public resistance
- New waste management and treatment strategies are needed i.e.
  - waste reduction, waste separation, distribution of authorities etc.
- Treatment technologies must be appropriate for the Thai specific MSW
- Government must provide suitable conditions for advanced MSW treatment
Questions and Answers

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