Compact Fluidized Bed Incinerator
Introduction

RASCHKA = Fluidized bed incineration technology

- More than 60 years of experience
- Planning and construction of fluidized bed incinerator for:
  - Energy generation
  - Energy utilization
  - Environmentally friendly thermal recovery and disposal
- Range of capacity:
  - 0.5 to 85 MW = total technically and economically reasonable application area for the stationary fluidized bed combustion
- More than 100 references in Europe and Asia
Introduction

- Raw materials: liquid, pasty and solid potential recyclable materials, residuals and wastes
  especially
    - Sludge
    - Wastes from chemical industries
    - Wastes from paper and pulp industries
    - Inferior coal, low-grade coal
    - Industrial, refinery and coal slurries
    - Biomass, bark
    - Household waste, mechanical-biological recyclable waste
Introduction

RASCHKA- Conception of a compact Fluidized Bed Incinerator (FBI ~ 1 MW thermal capacity)

- Decentralized, thermal recovery and disposal directly on site
- Independent of large, central plants
- No sludge transportation

- Simple design
  - High availability
  - Simple operation
  - Low investment and operation cost

- Main components
  - Fluidized bed oven
  - Waster heat recovery or recuperator as air pre-heater, hot water boiler
  - Dry fuel gas cleaning

Example of compact fluidized bed incinerator operational since 2008
## Compact FBI Capacity

### Thermal utilization and disposal of sludge and screenings

#### Fuel data

<table>
<thead>
<tr>
<th></th>
<th>sludge</th>
<th>screenings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dry solids (ds) – content</td>
<td>%</td>
<td>23-30</td>
</tr>
<tr>
<td></td>
<td></td>
<td>21</td>
</tr>
<tr>
<td>Organic dry solids (ods) -content of ds-</td>
<td>%</td>
<td>51</td>
</tr>
<tr>
<td></td>
<td></td>
<td>80</td>
</tr>
<tr>
<td>Lower heating value (lhv) of odS</td>
<td>MJ/kg</td>
<td>25</td>
</tr>
<tr>
<td></td>
<td></td>
<td>19</td>
</tr>
</tbody>
</table>

#### Throughput in operation of 7.500 h/a.

<table>
<thead>
<tr>
<th></th>
<th>sludge</th>
<th>screenings</th>
<th>total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Throughput raw</td>
<td>t/a</td>
<td>7.000 - 9.130</td>
<td>401</td>
</tr>
<tr>
<td></td>
<td></td>
<td>7.401 - 9.531</td>
<td></td>
</tr>
<tr>
<td>throughput raw</td>
<td>kg/h</td>
<td>933 - 1.217</td>
<td>54</td>
</tr>
<tr>
<td></td>
<td></td>
<td>987 - 1.271</td>
<td></td>
</tr>
<tr>
<td>throughput ds</td>
<td>kg/h</td>
<td>280</td>
<td>11</td>
</tr>
<tr>
<td></td>
<td></td>
<td>291</td>
<td></td>
</tr>
<tr>
<td>throughput water</td>
<td>kg/h</td>
<td>653 - 937</td>
<td>43</td>
</tr>
<tr>
<td></td>
<td></td>
<td>696 - 980</td>
<td></td>
</tr>
</tbody>
</table>
Process Description

- **Target:**
  - Compact plant size with a small footprint requirement
  - Simple system design
  - User friendly, reliable and high availability
  - Simple, pragmatic and cost-effective solution

- **Process advantage:**
  - No thermal (pre) drying
  - No conditioning with high calorific (substitute) fuels
  - No improvement in the mechanical dewatering

- **Compact FBI provides:**
  - Recovery of released energy in the process of combustion
  - Recirculation of energy in the process
  - Pre-heating the combustion air to 600-650°C by heat exchanger utilizing hot flue gas (870°C)
  - Further heating up of the combustion air to 950°C – if required –
  - Injection of biogas in the fluidized bed – if required –
Process Description

Heating combustion chamber

Natural gas

Fuel air 600° - 950° C

Combustion air 600° - 650° C

Fluidized Bed Incinerator

sludge, screenings

Biogas (if required)

Flue gas 870° C

Air pre-heater (recuperator)

Combustion air ~ 25° C

Boiler

Fuel gas cleaning

Ashes

Clean gas
Process Description
Process Description

Process Parameters

Incineration at 870° C, temporary addition of natural gas and/or biogas

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
<th>Unit</th>
<th>Design point</th>
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</thead>
<tbody>
<tr>
<td>Combustion air 600° C</td>
<td></td>
<td>$m_n^3/h$</td>
<td>3.000 - 3.300</td>
</tr>
<tr>
<td>Natural gas (34 MJ/$m_n^3$) in incinerator</td>
<td></td>
<td>$m_n^3/h$</td>
<td>Up to 60</td>
</tr>
<tr>
<td>Biogas (22 MJ/$m_n^3$) in fluidized bed (Lances)</td>
<td></td>
<td>$m_n^3/h$</td>
<td>Up to 30</td>
</tr>
<tr>
<td>Fuel gas 870° C</td>
<td>Flow (wet)</td>
<td></td>
<td>4.000 - 4.700</td>
</tr>
<tr>
<td>-- $N_2$</td>
<td>Vol.-%</td>
<td></td>
<td>56 - 60</td>
</tr>
<tr>
<td>-- $O_2$</td>
<td>Vol.-%</td>
<td></td>
<td>8 - 9</td>
</tr>
<tr>
<td>-- $CO_2$</td>
<td>Vol.-%</td>
<td></td>
<td>5 - 6</td>
</tr>
<tr>
<td>-- $H_2O$</td>
<td>Vol.-%</td>
<td></td>
<td>25 - 30</td>
</tr>
<tr>
<td>- Ashes</td>
<td>kg/h</td>
<td></td>
<td>139</td>
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</tbody>
</table>
Plant description
Plant description
Emissions

- All emission limit values are within EU guideline 2000/76/EC or 17.BImSchV.

- Additional measures in case of higher sulfur content in feed:
  Addition of lime in sludge

- No need for NOx reduction (such as SCR, SNCR)
Front view of housing
Fluidized bed incinerator
Spreader for combustible feeding
Fuel injection lances
Fluidized bed discharge device
Conclusion

Compact fluidized bed incinerator

- State of the art, future-oriented solution for the decentralized, thermal recovery and disposal of residual and waste materials on site
- Fully functional, reliable, easy and economical installation and operation
- Compliance with all legal requirements regarding operational and emission limits
- Independence of large, centralized treatment facilities
- No transportation costs to central facilities
- Avoids the need for sludge transport and reduces CO$_2$ emission
- Combines economics and ecology