German Experiences on Alternative Technologies for the Thermal Treatment of Waste and BREF Waste Incineration

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During the last 40 years several “new and innovative” technologies for the thermal treatment of waste tried to enter the market. The European market only began to seriously reconsider the technologies during the early 1990’s and this was driven by the political desire to avoid the use of incineration. Most of the processes require extensive pre-treatment of the MSW (Municipal Solid Waste). Now we have to decide how to handle the information during the BREF Process Waste Incineration.
Development of Alternative Technologies for the Thermal Treatment of Waste


“Status of Alternative Techniques for Thermal Waste Treatment”

Will be uploaded on BATIS as German Position and information
Criteria for Thermal Treatment Processes

Based on information at hand, data was structured according to following criteria:

- State of the art (as in VDI 3460, see next tables)
- Necessary (pre-) treatment effort
- Type and quality of products (eventually as input for follow-up facility)
- Complexity
- Economic efficiency
Criteria for Thermal Treatment Processes

Where a topic description refers to a Technical Readiness Level - TRL, the following definitions apply, unless otherwise specified:

- TRL 1 – basic principles observed
- TRL 2 – technology concept formulated
- TRL 3 – experimental proof of concept
- TRL 4 – technology validated in lab
- TRL 5 – technology validated in relevant environment (industrially relevant environment in the case of key enabling technologies)
- TRL 6 – technology demonstrated in relevant environment (industrially relevant environment in the case of key enabling technologies)
- TRL 7 – system prototype demonstration in operational environment
- TRL 8 – system complete and qualified
- TRL 9 – actual system proven in operational environment (competitive manufacturing in the case of key enabling technologies; or in space)
### Development status of thermal waste treatment processes according to [VDI 3460](#) (simplified).

<table>
<thead>
<tr>
<th>Devel. status</th>
<th>Status Regarding</th>
<th>Minimum Requirement</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Plant/Process</td>
<td>bench-scale tests, mass and energy balance of core plant</td>
</tr>
<tr>
<td></td>
<td>Input/Output Materials</td>
<td>descriptive analysis of input and output materials (quality, quantity)</td>
</tr>
<tr>
<td></td>
<td>Market Potential</td>
<td>assessment of market potential of a full-scale plant based on bench-scale test results</td>
</tr>
<tr>
<td></td>
<td>Scale-up</td>
<td>description of risks and opportunities of a scale-up, design of a pilot plant</td>
</tr>
<tr>
<td>2</td>
<td>Plant/Process</td>
<td>steady-state operation of a pilot plant, mass and energy balances of a core plant</td>
</tr>
<tr>
<td></td>
<td>Input/Output Materials</td>
<td>analysis of input and output materials (quality, quantity); discussion of opportunities and limitations of input materials</td>
</tr>
<tr>
<td></td>
<td>Market Potential</td>
<td>prediction of market potential of a full-scale plant</td>
</tr>
<tr>
<td></td>
<td>Scale-up</td>
<td>description of technical conditions for a scale-up, further unit operations needed for material feeding and discharge, design pilot plant</td>
</tr>
<tr>
<td></td>
<td>Operation</td>
<td>assessment of potential operating problems (corrosion, erosion, scaling…)</td>
</tr>
</tbody>
</table>
## Development status of thermal waste treatment processes according to [VDI 3460] (simplified).

<table>
<thead>
<tr>
<th>Plant/Process</th>
<th>steady-state operation of a pilot plant over a prolonged period, measurement of emissions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Input/Output Materials</td>
<td>testing of the process-specific products concerning their environmental relevance and utilization options</td>
</tr>
<tr>
<td>Market Potential</td>
<td>description of the market potential of a full-scale plant</td>
</tr>
<tr>
<td>Scale-up</td>
<td>technical and economic interpretation of measurement and analysis results related to a full-scale plant, size of equipment, materials, expected construction and operating costs of a full-scale plant, operating costs of a full-scale plant, costs per Mg of waste</td>
</tr>
<tr>
<td>Operation</td>
<td>assessment of the expected run time, plant availability and service life of a planned full- and service life of a planned full-scale plant</td>
</tr>
</tbody>
</table>
### Development status of thermal waste treatment processes according to [VDI 3460] (simplified).

<table>
<thead>
<tr>
<th>Plant/Process</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Normal operation of full-scale plant over a period of one to two years, confirmation to two years, confirmation of mass and energy balances, emission values</td>
<td></td>
</tr>
<tr>
<td>Demonstration of the suitability of the plant for then planned input materials, planned input materials, marketing potential of typical products generated by the process</td>
<td></td>
</tr>
<tr>
<td>Validation of capital and operating costs (business plan)</td>
<td></td>
</tr>
<tr>
<td>Demonstration of availability and runtime</td>
<td></td>
</tr>
<tr>
<td>Normal operation of full-scale plant over several years, assessment of environmental relevance of the process and plant</td>
<td></td>
</tr>
<tr>
<td>Demonstration of disposal of input materials, demonstration of the marketing of process-specific products</td>
<td></td>
</tr>
<tr>
<td>Traceable description of capital and operating costs over several years</td>
<td></td>
</tr>
<tr>
<td>Optimization efficiency, availability, runtime</td>
<td></td>
</tr>
</tbody>
</table>
Criteria for Thermal Treatment Processes

Systematic VDI 3460 Blatt 1 Template for the assessment of development status (DS) of thermal waste treatment systems:

- TRL 1 to TRL 4 correspond to DS 1 VDI 3460
- TRL 5 to TRL 6 correspond to DS 2 VDI 3460
- TRL 7 correspond to DS 3 VDI 3460
- TRL 8 correspond to DS 4 VDI 3460
- TRL 9 correspond to DS 5 VDI 3460
Pyrolysis as a Stand-alone Process

Waste Pyrolysis Plant, Burgau

**Input:** household waste, bulky waste, sewage sludge

**Characteristics:** co- treatment of sewage sludge contaminated with chrome

→ low process temperature/ lack of oxygen avoid formation of chrome IV and release of heavy metals
Pyrolysis as a Stand-alone Process

Waste Pyrolysis Plant, Burgau

Plant in operation: 1984 - present

Capacity: 2 x 3 Mg/h
Configuration: 1 X 2.2 MW CHP
Process: pre-shredding, pyrolysis at 470 °C – 500 °C, pyrolysis-gas combustion at 1,250° C
Pyrolysis as a Pre-treatment Process

ConTherm-Process

1. Reststoffbunker
2. Zerkleinerer
3. Vorlagebunker
4. Krananlage
5. Materialschleuse
6. Pyrolysedrehrohr
7. Brenneranlage
8. Austrag Pyrolysefeststoff
9. Gebläse
10. Zyklonentstauber

Rauchgas zum Kessel
Pyrolysegas zum Kessel
Pyrolysekoks zum Kessel
Inertes Metalle
Pyrolysis as a Pre-treatment Process

Example: ConTherm

Pyrolysis drum (500 °C)

Co-incineration of gas and external conditioned coke in hardcoal boiler
Pyrolysis as a Pre-treatment Process

ConTherm-Process in RWE power plant Hamm

**Input:** pre-processed high calorific waste

**Process:** adapted to the waste pyrolysis plan at Burgau, start up in 2001

**Pyrolysis only:** thermal use of the synthesis gas in a coal-fired powerplant

**Capacity:** 100,000 Mg/a

**Thermal input:** 75 MW
(waste ~ 90 %, gas ~ 10 %)

**Shutdown** of the plant in 2009 after a damage for economic reasons
Pyrolysis as a Pre-treatment Process

ConTherm-Process in RWE power plant Hamm

Gasification as a Pre-treatment Process

Envirotherm – ZWS Rüdersdorf
Gasification as a Pre-treatment Process
Example: Envirotherm – Rüdersdorf

- **Input RDF**
- **Circulating fluidized bed gasification (900-950 °C)**
- **Gas to calciner of cement kiln (900-950 °C)**
- **Solid residues to raw meal mill**

Reactor during installation
Gasification as a Pre-treatment Process

Envirotherm – ZWS Rüdersdorf

**Input:** mixed municipal waste

**Capacity:** 250,000 Mg/a

**Operation:**
1996 - present
Alternative Technologies for the Thermal Treatment of Waste

Main targets for future waste treatment processes

✓ Destroy toxic organic components in the waste
✓ Reduce volume and amount of the waste
✓ Avoid emissions to air, water and soil
✓ Produce reusable and recyclable fractions
✓ Avoid landfill
✓ Produce heat and electrical power or a secondary fuel
Thank you for your attention!

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