Smoking with smoke condensate

Contemporarily technique for modern requirements of smoked food
Overview

• Smoking – a traditional process
  – Smoking methods in comparison
  – Consideration of environment

• Manufacturing and characterization of smoke condensates

• Smoking with smoke condensates:
  – *Tarber Smoke Master* – smoke generation
  – *SmartSmoke* - cold smoking technology

• Benefits for the consumer

• Conclusion
Direkt smoking with sawdust
Indirect smoking – combustion smoke
Indirect smoking – friction smoke
Indirect smoking – steam smoke
Indirect smoking – smoke condensate
Worst case scenarios
Disposal of ashes
Installation example – smoke condensate
**Environmental analysis (e.g. France)**

Population ~ 60 million people consuming smoked fish and meat

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Fish</td>
<td>25,000 Tons</td>
</tr>
<tr>
<td>Meat</td>
<td>125,000 Tons</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>150,000 Tons</strong></td>
</tr>
</tbody>
</table>

**Composition pyrolised wood**

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Ashes</td>
<td>25 %</td>
</tr>
<tr>
<td>Charcoal</td>
<td>32 %</td>
</tr>
<tr>
<td>Water</td>
<td>27 %</td>
</tr>
<tr>
<td>Tar</td>
<td>16 %</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>100 %</strong></td>
</tr>
</tbody>
</table>

*Fengel, D. and Wegener, G.*
*WFood Chemistry, Ultrastructure, Reactions*
Walter de Gruyter, Berlin 1984 chap.12
Smoking with freshly generated smoke

3,000 t Sawdust

Heat

Smoke

480 t Tar

960 t Ashes

Smokehouse

87 t Cleaning detergent

1,440 t Pollution into environment
Smoking with purified smoke

- 3,000 t Sawdust
- 99.75% Tar recycled
- 99.75% Ashes recycled
- Smoke
- Smoke condensate
- Heat
- 7.7 t Ashes as raw material for road construction
- Smokehouse
- 18 t Cleaning detergents
Red Arrow production facilities

Manitowoc, WI
Production Facility

Manitowoc, WI
Distribution Center

Rhineland, WI
Production Facility
Red Arrow smoke generator
Red Arrow’s smoke condensate process starts with nature’s finest woods from managed forest programs for the construction industry which are beaten and sawn. The sawdust is a high quality by-product in the sawmill.

Labeling: Smoke flavor
- Direct application
- Drenching
- Dipping
- Spraying

Labeling: Smoke
- Smoke condensate
- Compressed air
- Gas phase
- Particle phase
- Real smoke for smoking food
Manufacturing process of Red Arrow smoke condensates

- Ingredients: freshly generated smoke from sawdust, water
- 60 % less wood consumption for the equal quantity of smoke
- Charcoal and tar at 99,75 % transferred to energy
- No wastewater
- No smoking emissions
- Burning gases filtered via biofilter
Facts about smoke generation

Facts:
- 100 % Sawdust
- 32 % Ashes
- 16 % Tar
- 52 % Smoke
Characterization of smoke condensates

- Content of acids
- Content of phenols / spectrum of phenols
- Content of carbonyls
- Density / Viscosity
- pH-value
- Benzo(a)pyrene- content
- Others
Table 20: The influence of smoke generation method on BaP Concentrations.

<table>
<thead>
<tr>
<th>Smoke generation</th>
<th>N</th>
<th>BaP Concentration (µg/kg)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Median</td>
</tr>
<tr>
<td>Burning of saw dust</td>
<td>411</td>
<td>-----</td>
</tr>
<tr>
<td>Burning of woodchips</td>
<td>55</td>
<td>-----</td>
</tr>
<tr>
<td>Friction of wood</td>
<td>13</td>
<td>-----</td>
</tr>
<tr>
<td>Overheated steam</td>
<td>6</td>
<td>-----</td>
</tr>
<tr>
<td>Liquid smoke</td>
<td>9</td>
<td>-----</td>
</tr>
</tbody>
</table>

Table 21: The influence of smoke distribution source on BaP Concentrations.

<table>
<thead>
<tr>
<th>Smoke distribution</th>
<th>N</th>
<th>Median</th>
<th>Mean</th>
<th>P95</th>
<th>Maximum</th>
</tr>
</thead>
<tbody>
<tr>
<td>Direct</td>
<td>257</td>
<td>-----</td>
<td>0.64</td>
<td>-----</td>
<td>29.63</td>
</tr>
<tr>
<td>Indirect</td>
<td>321</td>
<td>-----</td>
<td>0.15</td>
<td>-----</td>
<td>3.50</td>
</tr>
<tr>
<td>Liquid smoke</td>
<td>9</td>
<td>-----</td>
<td>0.14</td>
<td>-----</td>
<td>0.60</td>
</tr>
</tbody>
</table>

Where "N" is the number of samples tested. Median and P95 values may be found in the full EFSA report page 25 & 26.

Note: The current EFSA maximum allowable limit for BaP is 5.0 µg/kg. This limit may be lowered to 1.0 µg/kg.
The impacts of smoke

- Smoke colour (carbonyls)
- Smoke flavour (phenols)
  - taste
  - Smell
- Texture (phenols, acids)
- Preservation
  - microbiological (acids, phenols)
  - antioxidative (phenols)
Smoke generation with Tarber Smoke Master

Partikelgrößenverteilung ohne Umluft

Partikelgrößenverteilung ohne Umluft

Partikeldurchmesser in µm

Verteilung in %

Partikeldurchmesser in µm

Verteilung in %
Distribution of particles: 
atomization without circulation fan

85% < 1,00 µm  
98% < 5,00 µm  
100% < 57,00 µm
Facts for the optimal distribution of particles

- Special calibrated atomizing nozzles
- Flow
  - max. 5 l/h per nozzle
- Exactly controlled air pressure at nozzle
  - min. 5.5 bars per nozzle
- Stopping circulation fan during atomization
- High concentrated smoke condensates
- Smoke condensates with low viscosity
  - < 20mPa*s
- Exactly controlled atomization intervals
- Quantity of generated smoke
Parameters with influence to smoke generation

- Smoke density
  - atomization intervals
  - flow of smoke condensate (l/h)
- Temperature
- Relative humidity
- Fan speed
- Time
Smokehouse requirements

- Dampers for fresh air intake and exhaust must be able to close during smoking process
- No leakages in smokehouse (e.g. door sealings)
- No steam inlet into closed smokehouse (e.g. moisturization, heating system)
- Equal temperature distribution in smokehouse
- Temperature and humidity control must exist
- Air pressure of at least 7,0 bars must exist
- Air flow of 200 l/min per nozzle (dry, no particles and oil-free)
ROI - Calculation

Product: Wiener Sausage
Red Arrow product: SmokEz® Select Enviro 24

Processor Data:
- Production days / week: 5
- Production hours / day: 24
- Amount of Smokehouses: 4
- Trolleys / Smokehouse: 6
- Weight / trolley in kg: 120
- Total Processing Time in min: 180
- Total Smoking Time in min: 35

Costs

<table>
<thead>
<tr>
<th>Costs</th>
<th>traditional</th>
<th>SmokEz®</th>
</tr>
</thead>
<tbody>
<tr>
<td>Costs wood chips / trolley</td>
<td>0,09 €</td>
<td>1,15 €</td>
</tr>
<tr>
<td>Total costs / trolley</td>
<td>3,82 €</td>
<td>1,60 €</td>
</tr>
<tr>
<td>Price / kg</td>
<td>0,032 €</td>
<td>0,013 €</td>
</tr>
</tbody>
</table>

Amortisation:
- Investment Tarber Smoke Master: 79,500,00 €
- Total costs SmokEz / week: 1,536,00 €
- Total costs traditional / week: 3,667,20 €
- Cost savings / week: 2,131,20 €

Total amortisation within 37 Weeks
SmartSmoke – cold smoking technology

www.CleanSmoke.info
External smoke generator

Fully automated (type with TG-1200MS)
Installation example / operating mode
## ROI Calculation

Comparison of smoke generation methods. Smoked product = Salami sausage, capacity = 3x 54 trolley smoke houses, load = 300 kg / trolley, production volume = 162 trolleys / week = 48.8 tons / week

<table>
<thead>
<tr>
<th>Costs / trolley</th>
<th>Costs traditional</th>
<th>Costs SmartSmoke</th>
</tr>
</thead>
<tbody>
<tr>
<td>Smoking material</td>
<td>0.42 €</td>
<td>2.80 €</td>
</tr>
<tr>
<td>Energy smoke generation</td>
<td>0.08 €</td>
<td>0.07 €</td>
</tr>
<tr>
<td>Energy afterburner</td>
<td>2.63 €</td>
<td>n/a</td>
</tr>
<tr>
<td>Labor</td>
<td>2.77 €</td>
<td>0.46 €</td>
</tr>
<tr>
<td>Cleaning time smoke generator</td>
<td>0.35 €</td>
<td>0.10 €</td>
</tr>
<tr>
<td>Maintenance smoke generator</td>
<td>0.02 €</td>
<td>n/a</td>
</tr>
<tr>
<td>Spare parts smoke generator</td>
<td>0.06 €</td>
<td>0.01 €</td>
</tr>
<tr>
<td>Maintenance afterburner</td>
<td>0.06 €</td>
<td>n/a</td>
</tr>
<tr>
<td>Spare parts afterburner</td>
<td>0.09 €</td>
<td>n/a</td>
</tr>
<tr>
<td>Cleaning detergents</td>
<td>0.73 €</td>
<td>0.24 €</td>
</tr>
<tr>
<td>Water</td>
<td>0.22 €</td>
<td>0.07 €</td>
</tr>
<tr>
<td>Disposal tar and ashes**</td>
<td>0.60 €</td>
<td>n/a</td>
</tr>
<tr>
<td>Legal exhaust air measurement</td>
<td>0.10 €</td>
<td>n/a</td>
</tr>
<tr>
<td><strong>Total costs / trolley:</strong></td>
<td>8.13 €</td>
<td>3.75 €</td>
</tr>
<tr>
<td><strong>Total costs / kg smoked Salami:</strong></td>
<td>0.027 €</td>
<td>0.013 €</td>
</tr>
</tbody>
</table>

**Total costs combustion smoke generator with afterburner / week:** 1.312.20 €  
**Total costs SmartSmoke / week:** 631.80 €  
**Cost savings / week:** 680.40 €  
**Investment SmartSmoke:** 60.000.00 €

**ROI within:** less than 2 years

*The calculation takes the following fictitious costs as a basis:  
Labor costs of about 32.00 € / h; costs for electricity of about 0.16 € / kWh;  
costs for gas of about 0.45 € / m³; costs for fresh and waste water of about 5.00 € / m³;  
costs for pressurized air of about 0.05 € / m³; costs for cleaning detergent of about 1.70 € / kg;  
costs for technicians of about 55.00 € / h; costs for disposal of tar and ashes of about 0.60 € / kg  
(calculated without costs for rental of collecting containment and transportation by truck)*
Your benefits

- Coventional smoking process will be exchanged
- Smoke quantity is exactly dosed
- Less dirt (tar, ashes) in smokehouses
- Reduced need for cleaning detergents
- No tar, no ashes, no fire
- No explosion hazard
- Healthier food products
- Constant product quality
- Smoking process without emissions
Excellent smoke quality

• New smoke quality seal
  – Differentiation from competition
  – Focus on consumers’ need

protected brand label
Benefits for consumers
Benefits for consumers

- Healthier food, no toxic substances (e.g. PAH4, 3-MCPD)
- Increased product safety, because smoke is generated under control, purified and applied in the exact quantity needed
- Reduction of CO2 emissions up to 80% compared to combustion smoke
- Minimized wastewater contamination, less water consumption, less need for cleaning detergents, no ashes, no tar
- Protection of resources, reduced need for wood
- Controlled smoke quality by exactly guided manufacturing process of smoke condensates
- Taste variety by the use of different wood species (e.g. oak, beech, maple, cherry tree, apple tree, hickory, pine-tree), means a larger product range to choose from

→ Constant quality of smoked products
Conclusion

The use of regenerated smoke for smoking processes provides the possibility of bringing cost efficiency, ecological awareness and safety thinking in line and puts the consumers need for trust and healthy nutrition in the focus at the same time.
Thank you for your attention!

Your partner for innovative smoking technology