2020: employees: 16,000
turnover: 3,500 Mil.

DRYficiency

Stefan Puskas
21.04.2021
Estimates show that 12-25% of the national industrial energy consumption in developed countries is attributable to industrial drying.
DemoPlant Uttendorf (Austria)

Brick-output: ~280 to/d
Conventional process

- Kiln: ~1000 °C
- Gas burner
- Hot air from kiln: 75 t/h @ 150°C (2% RH)
- Additional gas burner
- Drying agent (air)
- Recirculating fans
- Tunnel Dryer: Drying capacity 2.6 t/h
- Exhaust air: 50°C (60% RH)
- Wet product: 10 t/h (28% moistness)
- Dry product: (2% moistness)
Flue gas 31%

Wet air dryer 36%

Gas station 100%

In Product 8%

Others 25%

stefan.puskas@wienerberger.com
Conventional process

- **Fired Brick**: 50 °C
- **Cooling air from ambient**: 20 °C
- **Tunnel Dryer**: Drying capacity 2.6t/h
- **Kiln**: ~1000 °C
- **Gas burner**: 75 t/h @ 150 °C (2% RH)
- **Recirculating fans**: Hot air from kiln
- **Exhaust air**: 50 °C (60% RH)
- **Wet product**: 10 t/h (28% moistness)
- **Dry product**: (2% moistness)
- **Dry Brick**: 50 °C
- **Gas burner**: additional
- **Drying agent (air)**: from kiln
- **Conventional process**
DryF heats the return track; the products spend approximately 13% of the overall drying time in that part of the dryer.
1st stage: Absorption Heat Pump
2nd stage: DryF Heat Pump

Compressor: 8 piston compressors
Refrigerant: R-1336-mzz(Z) “OpteonMZ”
Lubricant: Fuchs Schmierstoffe GmbH
Goal of DryF is to demonstrate the functionality and reliability of high-temp. HPs!

**HPs in a brick factory:** HPs are the best available instruments to recover latent heat from the moist-air flows (e.g. out of the dryers).

**High temp HPs (like DryF):** Make sense when an energy source “not very much colder” then the needed one is available (e.g. 1-stage = absorption HP)

**Other benefits to be considered**
- Water recovery due to condensation in the heat-recovery (~ 1.2 kgH2O/kWh)
- Reduction of air-mass flows through the dryer
Energy balance

heat input and output, electricity, kW

<table>
<thead>
<tr>
<th>Temperature (°C)</th>
<th>Pel</th>
<th>Qheat</th>
</tr>
</thead>
<tbody>
<tr>
<td>120</td>
<td></td>
<td></td>
</tr>
<tr>
<td>140</td>
<td></td>
<td></td>
</tr>
<tr>
<td>150</td>
<td></td>
<td></td>
</tr>
<tr>
<td>160</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Status of operating hours: 2.034 h
Trial operation

- Various HTHP, Arpagaus et al. 2018
- 50% COP Carnot (Tsink=120°C)

Calculated impact of HP assisted drying

**CO₂-emission factor** natural gas
Austria: 271 g/kWh  
EU: 290 g/kWh

**Primary energy factor for gas**
Austria: 1.18 kWh/kWh  
EU: 1.36 kWh/kWh

**Primary energy factor for electricity**
Austria: 1.91 kWh/kWh  
EU: 2.10 kWh/kWh

Compare:
Gas-driven drying vs. HP-assisted drying (el)

- CO₂ emissions factors:
  - natural gas: 271 g/kWh
  - electricity: 258 g/kWh

- T<sub>source</sub>: ~89 °C  
  (dT: -3 to 6K)

Grant Agreement No 723576 – Energy Efficiency
Thank you for your attention!

stefan.puskas@wienerberger.com