HeatBooster

Industrial Heat Pump System
TECHNICAL POTENTIAL OF PROCESS HEAT IN EUROPE

Process heat in industry

Technical potential of process heat in Europe accessible with industrial heat pumps

Energy demand between 100 and 150°C amounts approx. 20% of 626 PJ

➢ 34 TWh

Based on Eurostat data from 2012 of 33 countries, Neillissen and Wolf (2015)

These temperature range is a perfectly match for the HeatBooster
ORC-System and high temperature heat pump using the same core technology
STRONG AND ESTABLISHED PARTNERS: AVL, GWK AND CHEMOURS

- **AVL**
  - Collaborated since 2011
  - World’s largest independent engine design company
  - > 8,000 employees and revenue of € 1.3 Billion (2015)
  - AVL has invested in Viking Heat Engines

- **The Chemours Company**
  - Collaborated since 2015
  - Large chemical company developing and producing environmentally friendly working fluids/refrigerants and more

- **GWK**
  - Supplier of high-quality cooling and heating technology products
  - Current manufacturer of CraftEngine™ / HeatBooster process modules
DEVELOPMENT OF A PRODUCT FAMILY

1. Generation: Demonstrators
2. Generation: CraftEngine™ 10 & 40
2. Generation: HeatBooster S4
3. Generation: CraftEngine™
3. Generation: HeatBooster

Current available products:
Future available products

Product diversification

10 kWₑₚ
10 – 40 kWₑₚ
200 kWₑₚ

Time
WORLDWIDE FOOTPRINT, OPERATIONAL UNITS IN A LARGE VARIETY OF APPLICATIONS

USA
Unit: 1xCE10
Application: Exhaust Gas

BARBADOS
Unit: 1xCE10
Application: Exhaust gas

UK
Units: 2xCE40
Application: Modular waste pyrolyses unit (new)

NORWAY
Units: 3xCE10 & 1xCE40
Application: Municipal waste incineration

GERMANY
Units: 3xCE40
Application: Biogas CHP

JAPAN
Units: 2xCE10
Application: Geothermal & sludge incinerator

COLUMBIA
Unit: 1xCE40
Application: Rice Husk Incineration

SOUTH AFRICA
Units: 1xCE40
Application: Temperature regulation

GERMANY (test centre in Remscheid)
Units: 1xCE10 & 2xCE40
1xHeatBooster S4
All running for test purposes

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THE FIRST CLOSED-LOOP HEAT PUMP TO REACH 160°C USING HFO FLUIDS

Heat pump type: Industrial

- Can provide both cooling and heating
- 0 – 160°C
- 50 – 4,000 kW
- 100 – 6,000 kg/h

Typical applications

- Process heating
- Drying applications
- District heating
- Sterilization & Pasteurization

Can provide both cooling and heating
**HOW IT WORKS**

Input temperature range: 10 – 120 °C

Output temperature range: 70 – 160 °C

$Q_{in}$ 30-180 kW<sub>th</sub>

Useful heat on higher temperature level

$Q_{out}$ 50-200 kW<sub>th</sub>

COP* = 2 to 9

5-60 kW<sub>el</sub>

*Coefficient of Performance (COP) indicates the ratio of output heat divided by electrical input added to the reciprocating compressor. The ratio depends strongly on the temperature lift.

The given values are example values.
UNIQUE PISTON TECHNOLOGY

• Robust and already proven technology due to the ORC-Systems

• Permanent magnet synchronous motor for variable speed control: 300-1,500 rpm $\rightarrow$ power control between 20-100% $\rightarrow$ high flexibility

• Water cooled motor for very high temperature applications with integrated thermal monitoring

• Optimized for parallel operation, where several compressors can run in parallel

• Multi-compressor phase synchronization for low vibrations and pulsations, if needed

• Use of low-friction bearings $\rightarrow$ high efficiency

• Internal oil circuit with oil filter $\rightarrow$ long service life, easy to maintain
THE TESTBED IN REMSCEHD FOR ORC-SYSTEMS AND HEAT PUMPS

• Designed and built to automotive standards
• 6 independent test beds
• Heat source up to 250°C and 1 MW thermal
• Heat sink up to 1,2 MW thermal
• AVL Puma control and automation system, allows 24/7 operation with up to 1000 measurement channels
• High speed pressure measurement incl. in-cylinder pressure
• Possible to measure key parameters such as: pressure, temperature, flow rate, viscosity, vibrations, etc.
POSSIBLE APPLICATIONS

PET bottle industry
• Providing heat between 100°C and 150°C

Paper industry
• Huge energy demand

Drying processes
• Paint shops
• Spray drying
• Brick drying

Sugar industry
• Processing of sugar beets requires a lot of high temperature heat between 80-150°C

District heating
• Providing steam in combination with district heating grids
• As peak load solution and in combination with thermal storages edited

Brewery industry
• Brewing process (mashing, lautering, wort boiling)
• Filling processes (sterilisation, washing, pasteurisation)
A 240 kW<sub>el</sub> CHP Unit Combined with the HeatBooster Increases the High-Temperature Heat by 140 %

- Increasing the overall efficiency of the CHP system
- Utilizing the jacket water heat also during summers
HEATBOOSTER CASE – DRYING OF CAR PAINT

One HBS-4 saves 430 t CO₂ per year

Industry Targets: Toyota’s goal is to cut 50% of the CO₂ emission by 2025 and zero emission by 2050
The cascade connection allows for a temperature lift of 45 °C. Comparatively, the temperature lift of 60 °C with one large system, which results in a lower COP.

The given values are example values.
Drying efficiency +75%

Cost per brick -15%

Heat pumps are very much capable of replacing gas burners in these types of applications

Sander Geelen, member of the External Experts Advisory Board, DryFiciency project
SUMMARY OF THE HEATBOOSTER

- **Products:** Compressors and complete heat pumps
- **Maximum heat source temperature** up to 120°C
- **Maximum heat sink temperature** up to 160°C
- **Scalable:** 50 to 4,000 kW (in the near future even up to 20 MW)
- **Integration:** Plug-and-play (hot water or steam)
- **Service life:** Up to 20 years
- **Maintenance:** Less than once a year, monitored 24/7
- **Quality:** CE approved, ISO certificated suppliers
- **The first three HeatBooster will be installed in the end of this year**
Our Vision is to accelerate the world’s energy transition towards a sustainable future.

www.vikingheatengines.com