Update on Gas-Fired Heat Pump Development at Warwick

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i-STUTE, Loughborough, June 2015
Heat Pump Concept

- Box-for-box exchange for conventional gas boiler
- Air source
- 30-40% reduction in gas consumption
Original version, ‘Pre i-STUTE’
Tested May 2011

- Top valve assembly
- Bottom valve assembly
- Generators
- Evaporators
- Gas heat exchanger
- Burner
‘Pre i-STUTE’ Machine

- Machine suffered from excessive heat loss and high thermal mass in complex valve assemblies
- Machine produced hot water from gas, but at an efficiency little better than a gas boiler!
- Decision was made at the start of the i-STUTE project to simplify the system and make it less compactly packaged (for easier debugging)
- Switch from gas to electrical heat input to focus development on the heat pump itself
‘i-STUTE’ Simplified Lab System
Test Conditions

Driving Temperature: 150°C (Electrical Heat Input)

Evaporating temperature: 0-7°C

Delivery temperature:
   Underfloor heating: 36°C flow, 26°C return
   Low temp. radiators: 50°C flow, 40°C return
Test Results

COP (Heat Output to Heat Input) vs Heating Power [kW]

- Low Temp Rads
- Underfloor Heating
- Low Temp Rads Fit

WARWICK
Generator Thermal Mass

- The generator is effectively a thermally driven compressor, and is the most critical part of the design.
- The generator flanges contained 10 kg of stainless steel which reduced the COP.
Generator Thermal Mass

- New domed end flange design reduces the mass of steel from 10kg to 2kg
- Currently undergoing manufacture
Test Results

Example case for model comparison

COP (Heat Output to Heat Input)

Heating Power [kW]
Predicted Performance

Model prediction for improved machine:

<table>
<thead>
<tr>
<th>Case</th>
<th>COP</th>
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<tbody>
<tr>
<td>Previous design – 10 kg steel</td>
<td>1.29</td>
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<tr>
<td>New design – 2 kg steel</td>
<td>1.35</td>
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Predicted Performance

• For the example case of underfloor heating at 7 kW heat output, the overall COP (heat output to higher heating value of gas input) could then reach 1.2

• An assessment of the performance with respect to the new Energy Related Products (ERP) labelling scheme is required to determine if our system would be rated A, A+ or A++
Test Facilities

- ‘ThermExS Lab’ Thermal storage test facility under construction.
- Will also be used as a heat source and sink for testing of the heat pump.
- Expected to be completed in the next few months.
Thank you

Questions?