Methods of reducing the district heating return temperature from the local substations

– Sensible regulation and smart control

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Background

1. Why LTDH?
2. Why low return temperature?
3. Difficulties
   - Thermal comfort
   - Dynamic heating load
   - Deviation between the design and practical situation
Reasons & substation layout

- Typical substation layout
  - HEX for DHW preparation

1. Ball valve
2. Thermostatic valve
3. Differential pressure controller
4. Strainer
5. Energy meter
Reasons & substation layout

- Storage tank for DHW preparation

1. Less peak load ???
2. Set point T of the tank
3. Circulation is necessary for comfort requirements

1. Problematic tank charging program
2. Large circulation heat loss
3. High DH return temperature
Proposed solution

- Piecewise large charging flow
- Small constant charging flow
Determination of the minimum charging flow

- Maintain required DHW temperature during any draw-off period
- Provide sufficient heat including the DHW consumption and heat loss
- Return temperature as low as possible
Demonstration building and dynamic modeling

- Typical multi-storey building in Copenhagen, 15 flats, 750 L tank, daily heat supply 142kWh, 50% for heat loss
Demonstration building and dynamic modeling

Dynamic results:
1. All temperatures
2. Heat flowrates in any heat transfer process
3. System hydraulic regulation
Model results

Piecewise charging

Constant charging flow
Model results

- Reduce the heat loss 50% -> 30%

Necessary charging flowrate

Critical temperatures
# Results comparison

<table>
<thead>
<tr>
<th>Measurements</th>
<th>Simulated cases</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>Reference case</td>
</tr>
<tr>
<td>Peak Flowrate [kg/s]</td>
<td>0.25</td>
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<tr>
<td>Avg. Return T [°C]</td>
<td>57.6</td>
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<tr>
<td>Average cooling [°C]</td>
<td>10.6</td>
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Further improvement
Conclusion

• The DH return temperature from the conventional storage tank system can be reduced with better regulated charging flow
• Reduce the system heat loss can help to reduce the average DH return temperature
• Practical DHW load profile is of great importance for the control
• Theoretically, the DH return temperature can be further cooled down by installing a circulation heat pump
• Future work:
  – Investigate the system performance with heat pump
  – Compare possible systems with different layouts
Thank you!

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