MULTI-transfer
Simulation of bidirectional heat transfer stations in district heating grids

Dr. Markus Rabensteiner
Reininghausstraße 13A,
A-8020 Graz
Austria
+43 664 88251830
markus.rabensteiner@4wardenergy.at
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- 01.04.2016 until 31.03.2018

Contents
- Investigation of a bidirectional heat transfer station
- Innovative control strategies for the integration of renewable heat sources
- Increasing the efficiency of heating systems
Initial situation in Austria

- District heating supplier
- Location with several district heating suppliers
- District cooling network

Initial situation in Austria

- District heating: 24%
- Furnance heating: 13%
- Floor/central heating: 63%

Introduction

Plant Simulation

Results

Summary

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Challenges

- Decreasing specific heat demand in existing and new buildings \( \rightarrow \) low heat density in a region
- Decentralized integration of (low temperature) heat sources of prosumers
- More flexible structures to enable open and modular heating systems
- Ensuring an all-season heat supply (various types of consumption) through a mix of centralized and decentralized heat sources
Legal requirements

- Equal rights and fairness for all customers → Who can feed in when and how much and at what conditions?
- Site and development safety:
  - Connection and feed-in obligations on the part of the municipalities
  - Financial penalties for large potential waste heat suppliers
- Normative adaptation and simplification of domestic water supply (legionella problem)
- Change of calibration and standardization of heat meters
Use cases

- Solar thermal energy supply on the secondary side
- Waste heat integration from medium (commercial) refrigeration plants on the secondary side
- Larger heat pump applications on the primary side (return cooling)
Integration options

- Flow from the return to the forerun
  - high pump performance (small volume flows / high differential pressures)
- Return rise
  - Pressure reducing valve in return or heat exchanger pump
  - Decreasing efficiency of the primary heat source (condensation boiler)
- Forerun rise
  - Pressure reducing valve in forerun or heat exchanger pump
90% of all collectors are flat plate collectors

\[ T \uparrow \Rightarrow \eta \downarrow \downarrow \]

Vacuum tube collectors are advantageous at higher temperatures. However, these are almost not be used because of the high prices.

Operation
- High-flow (return rise)
- Low-flow (forerun rise)
- Matched-flow (Flow from the return to the forerun)
Introduction

- Year-round use
- Waste heat from the freezing and standard cooling cells (e.g. supermarket)
- Max. waste heat temperature of 30 to 35°C
- Waste heat potential of a supermarket: ~250 MWh/a
Hydraulic schema

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flow

return

secondary side

primary side

heat reservoir

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Heat absorption from the grid
Flow from the return to the forerun
Return rise

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Forerun rise

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Objectives of the simulation

- While in a laboratory test, the control of a prosumer is examined, a numerical model is used to examine the effects of several prosumer on the entire grid.
Simulation of the secondary side

Introduction

Plant Simulation Results Summary

- metrological data
- consumer
- solar thermics
- energy balance
- heat reservoir
- bidirectional heat transfer station
Simulation of a single prosumer

- The forerun and return temperature of the district heating grid, at the point where the prosumer is located, is feed into the computer.
- The influence of other prosumers is not considered.
Simulation of a single prosumer

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Simulation of a single prosumer

Heat quantity [kWh]

Flow from the return to the forerun
Return rise

Forerun rise

grid → prosumer

prosumer → grid
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Simulation of a line of prosumers

- Simulation of a line of prosumers in a reference district heating grid
- Standardized design of a prosumer
- Arbitrary choice of locality
Simulation of a line of prosumers

- Simulation of a line of prosumers in a reference district heating grid
- Standardized design of a prosumer
- Arbitrary choice of locality
The objective of the research project MULTI-transfer is the exploration of a bidirectional heat transfer station for district heating grids.

- A simulation model depicts the secondary side.
- At present, the control can only be effected by the storage temperature.
- A model for investigation the thermo-hydraulic behaviour is planned.
- A laboratory test will be carried out in the coming weeks → Validation of the simulation model.