SHaKE
Sharing Knowledge on Energy Communities

Co-funded by the European Union

Module 5
Advanced systems in District Heating and Cooling

Part of the SHaKE Educational Package on District Heating and Cooling Systems

Question Bank

Reusable assessment and classroom discussion resource

Developing institution: Mines Paris – PSL
Erasmus+ KA220-HED Cooperation Partnerships in Higher Education
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https://www.shakeproject-dhc.eu/

Section 1: Overview and Objectives

1. What is the main goal of improving DHC network performance?
 a) Increase electricity generation
 b) Reduce return temperature
 c) Increase water consumption
 d) Eliminate heat exchangers

2. Which factor allows greater integration of renewable energy in DHC networks?
 a) Higher supply temperature
 b) Lower return temperature
 c) Increased pump speed
 d) Reduced pipe diameter

3. What is the typical consequence of high return temperature?
 a) Lower heat losses
 b) Higher pump efficiency
 c) Reduced renewable energy use
 d) Increased insulation thickness

4. Numerical application: If return temperature is reduced by 10°C and the energy savings are of 2% per °C, what is the total energy saving?

5. Which component is primarily managed by DHC operators?
 a) Customer radiators
 b) Primary network
 c) Secondary valves
 d) DHW taps

Section 2: Common Faults in DHC Networks

1. What percentage of faults are due to leaks in DHC networks?
 a) 10%
 b) 26%
 c) 42%
 d) 75%

2. Which issue is the most common in secondary systems?
 a) Fouled heat exchanger
 b) Poor hydraulic balancing
 c) Oversized pumps
 d) Broken sensors

3. Why does a missing thermostatic valve increase return temperature?
 a) It reduces flow rate
 b) It causes uncontrolled flow
 c) It lowers supply temperature
 d) It improves efficiency

4. Numerical application: If a network loses 8% of water volume annually and total volume is 500,000 m³, calculate leakage volume.

5. Which fault category includes actuator problems?
a) Heat exchanger
b) Control valves
c) Secondary systems
d) DHW architecture

Section 3: Secondary Side Design Recommendations

1. What is the main advantage of using V2V over V3V?
a) Easier hydraulic balancing
b) Lower return temperature
c) Higher pump speed
d) Increased bypass flow

2. Which radiator regime is considered low temperature?
a) 80/60°C
b) 75/55°C
c) 55/45°C
d) 65/55°C

3. Numerical application: Calculate ΔT for LT radiator with inlet 55°C and outlet 45°C.

4. Which DHW architecture uses no storage tank?
a) Instantaneous
b) Semi-instantaneous
c) Accumulation
d) Semi-accumulation

Section 4: Impact Analysis of Retrofit Actions

1. What is the typical gain in return temperature when switching to V2V with variable pump?
a) 1°C
b) 3°C
c) 9°C
d) 16°C

2. Why does bypass flow increase return temperature?
a) It reduces HEX efficiency
b) It mixes cooled and hot water
c) It lowers pump speed
d) It improves control accuracy

3. Which radiator type results in higher flow rate for same power?
a) HT radiator
b) LT radiator

c) Fan coil unit
d) Heating floor

4. Numerical application: If LT radiator requires 0.3 kg/s and HT radiator requires 0.2 kg/s for same power, what is the return temperature difference between the different temperature?

5. Which architecture allows secondary supply temperature below 60°C?
a) Global HEX
b) Parallel HEX
c) Instantaneous DHW
d) Storage tank DHW

Section 5: Heat Tariff Models

1. What is the main purpose of motivational tariffs?
a) Increase customer consumption
b) Encourage retrofit actions
c) Reduce gas prices
d) Eliminate DHW demand

2. Which component is typically included in a classical tariff?
a) Installed capacity
b) Waste heat incentive
c) Return temperature penalty
d) Flow-based bonus

3. Why does high gas price reduce payback time?
a) It increases retrofit cost
b) It increases energy savings
c) It lowers efficiency
d) It reduces demand

4. Numerical application: If retrofit saves €1,000/year and costs €4,000, calculate payback time.
(Expected: 4 years)

5. Which factor could be added to future tariff models?
a) Pipe diameter
b) Waste heat recovery
c) Pump speed
d) HEX material

Section 6: Fault Detection Methods

1. Which method relies on expert judgment and visualization?
a) Regression
b) Classification
c) Manual analysis
d) Clustering

2. What is the main limitation of threshold-based detection?
a) Requires labeled data

b) Needs high-resolution sensors
c) Cannot identify fault origin
d) Depends on clustering

3. Which technique groups data without labels?
a) Regression
b) Classification
c) Clustering
d) Thresholds

4. Numerical application: If valve opening deviation exceeds 3% threshold 10 times/day, is it considered faulty?

5. Which indicator compares measured and simulated valve opening?
a) Excess flow
b) Thermal signature
c) Normalized residual
d) DTLM variation