The INOGATE Programme

BUILDING PARTNERSHIPS FOR ENERGY SECURITY

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The analysis of the make-up water consumption and cost

AHED.120.MD

Outline

- Background information
- Introduction
- Consumption analysis
- Cost and sensitivity analysis
- Conclusion
Dwellings with District Heating in Hungary and Budapest

Number of Heated Dwellings

Year

Dwellings

Hungary - Total

Budapest
Decreasing Heat Demands - High Share of Natural Gas

Share of industrial heat demand has fallen from 50% to 25%.

80.6% of fuel consumption is natural gas

Share of renewables and communal waste is less than 5%.
Basic Data of Budapest DH System

- 2,345 MW installed heat source capacity
  - 728 MW (31%) CHP
  - 584 MW (25%) company-owned
  - 1,609 MW (69%) oil and natural gas fired
  - 1,269 MW (54%) participated in feed in tariff system
- 653 MW power capacity, 2 TWh/a electricity production
- Between 2000 and 2015:
  - 12.4-15.8 PJ/a heat production
  - 1.2-1.3 PJ/a heat loss of the distribution system
  - 430-660 th m³/a make up water consumption
  - 37-50 GWh/a electricity demand
- 525 km pipeline system
- 4,014 substations
The network condition and renovation - 1
The small primary commodity and welding defects can promote the corrosion damage
New trends in pipe reconstructions

Application of pre-insulated pipes with increased thickness of insulation

Testing co-insulated and flexible pipes
Time passed until damage – prefabricated concrete channels

Yearly frequency, No

Time passed until damage, years
Time passed until damage -

*Pre-insulated pipe systems*

**Yearly frequency, No**

<table>
<thead>
<tr>
<th>Time passed until damage, years</th>
<th>Yearly frequency, No</th>
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<td>0-1</td>
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<td>16-17</td>
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<td>18-19</td>
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Quality control of the pipeline construction – 1.
The target was to increase the quality

Previous state

Required state
Quality control of the pipeline construction – 2.

The target was to increase the quality

Previous state

Required state
Our future goal was - improving the quality of pipeline construction

The quality certification of the construction company

The quality certification of the primary commodity and manufacturer

Quality control of the welders and welding

Control of the construction

X-ray examination of welding
Background information

Daily make-up water consumption in CHP plant Kispesti, Budapest Hungary
Daily make-up water consumption in the CHP plant Kispesti, Budapest Hungary

Scale: HUF/Day, HUF/ hour

Target value

A hálózat térfogata, napi fogyasztás %-ban

Bad example

m³/Day

m³/hour
Daily make-up water consumption in the CHP plant Kelenföldi, Budapest Hungary

Napi átlagos pótvíz [m³/nap]

Target value

Scale: HUF/Day, HUF/hour

Bázis tűrés [m³/nap]
Napi átlagos [m³/nap]
Bázis min [m³/nap]

Good example
Our future goal was - improving the quality of pipeline construction

- The quality certification of the construction company
- The quality certification of the primary commodity and manufacturer
- Control of the construction
- Quality control of the welders and welding
- X-ray examination of welding
Monitoring of the DH network

1. Regular monitoring and reporting of the make-up water consumption – Leader of the energy management department

2. Regular monitoring of the pipes, fittings and their accessories – Leader of the network operation
Analysis of the DH network damages

1. Fixing the nature and causes of the damage, assessment of damages
2. Identify responsible for the damage, claim adjustment
3. Diagnose the reason of the network/pipe failure
4. Analysis of the failure and preparing regularly a report.
5. Making recommendations to prevent damage.
Analysis of the construction of the DH network damages

1. The quality control of the primary commodity and pipe manufacturer - *Purchasing department*

2. Checking of the quality certification of the construction company - *Purchasing department*

3. Control of the construction - *Quality Inspector*

4. Quality control of the welders and welding - *Quality Inspector*

The technical documentation of the construction should contain the quality certifications and check lists!
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Introduction – 1.

In frame of an energy audit the followings are checked:

- quality of water in the DH network;
- make-up water quality; and
- make-up water consumption.
The analysis of the make-up water consumption and cost

Introduction – 2.

Corrosion may occur inside or outside the system;

- To prevent **internal corrosion**, a water quality that does not cause corrosion is required;
- Oxygen causes corrosion and ordinary water contains oxygen;
- **External corrosion** can be avoided by securing a dry environment.
- The high consumption of make-up water probably will keep the pipe lines wet and cause not only outside corrosion, but will rapidly increase heat lost and operational cost as well.
The analysis of the make-up water consumption of the CHP 2.
The analysis of the make-up water cost of the CHP 2.

In 2012 overruns 260,995 m³/a

With 70 MDL/m³ 18,269,664 MDL/a
The analysis of the make-up water cost of the CHP 2.

Yearly overruns cost sensibility

Make-up costs

Make-up water cost 70 MDL/m3
The analysis of the make-up water cost of the CHP 2.

Acceptable Investment Costs, $10^6$/MDL at different interest rates
The analysis of the make-up water consumption of the HOB Sud
The analysis of the make-up water consumption of the HOB Sud

In 2012 overruns 6 402 m³/a
With 70 MDL/m³
448 140 MDL/a
22 407 EUR/a
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Conclusion and recommendation:

- The make-up water consumption is high
- Enhance the maintenance of the DH network
- Reduce water losses by replacing the most severely damaged, corroded and leaking pipes with modern pre-insulated pipes
- Free oxygen in water can cause corrosion
- Check the water quality in the DH network
To prevent pipe leakage the water quality should be regularly monitored!

The small primary commodity and welding defects can promote the corrosion damage.
Recommended water quality limits:

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<table>
<thead>
<tr>
<th>Measured data:</th>
<th>Partly desalinated</th>
<th>Desalinated</th>
</tr>
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<tbody>
<tr>
<td>pH at 25°C</td>
<td>9,8 ± 0,2</td>
<td>9,8 ± 0,2</td>
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<tr>
<td>Residual water hardness, °dH (German Hardness)</td>
<td>&lt; 0,2</td>
<td>&lt; 0,1</td>
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<tr>
<td>Conductivity at 25°C, µS/cm</td>
<td>&lt; 500</td>
<td>&lt; 25</td>
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<tr>
<td>Oxygen, mg/l (milligrams per litre)</td>
<td>&lt; 0,02</td>
<td>&lt; 0,02</td>
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<tr>
<td>Chloride, mg/l</td>
<td>&lt; 50</td>
<td>&lt; 3</td>
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<td>Sulphide, mg/l</td>
<td>&lt; 1</td>
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<td>Ammonia, mg/l</td>
<td>&lt; 5</td>
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<tr>
<td>Total iron content, mg/l</td>
<td>&lt; 0,1</td>
<td>&lt; 0,05</td>
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<tr>
<td>Total copper content, mg/l</td>
<td>&lt; 0,02</td>
<td>&lt; 0,01</td>
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Our future goal was - improving the quality of pipeline construction

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