Appropriate loss management: Experience of Budapest

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Construction of the water supply system of Budapest Waterworks

Typical data:

- Population: 2 million people
- Average produced water per day: 440,000 m³
- 89 pcs pressure zones
- 102 pcs pump stations (logical)
- 84 pcs pump stations (buildings)
- 67 pcs reservoirs
Managing physical losses in Budapest

- Enlargement of ALC activities
- Continuous night flow monitoring
- Consider more measurements on trunk mains
- Closely monitor the survey rates and hit rates
- Investigate methods of leaks in trunks
- Designing DMAs
- Using pressure management
History of leakage detection in Budapest

- ALC activity was outsourced in 2002
- ALC activity was sourced back in 2003
- ELL model was made in 2005
- Customer inventory was performed in 2006
- ALC team and accessories were upgraded in 2006
- DMAs were designed in 2007
- DMA installations are in progress from 2009
- DMA data collection is in progress from 2013
- DMA data are analyzed continuously from 2014
- ALC activity is developed on the basis of DMA data
There is a level of leakage below which it is not cost effective to make further investment or use additional resources to drive leakage down further. The value of water saved is less than the cost of making further reductions. This point has come to be referred to as the economic level of leakage (ELL).

Elements of value of water: pumping costs, abstraction charges, chemical costs

Costs of ALC: staff to locate leaks, vehicles, equipment, supervision and support.
Network efficiency and economy

Evolution of specific water losses

Evolution of NRW
Non revenue water in water balance in Budapest (2013)

Non revenue water ($m^3$)

- Unbilled metered consumption: 4%
- Service water: 4%
- Undermetering: 14%
- Leaks on pipes: 38%
- Leaks on connections: 39%

Non revenue water (HUF)

- Unbilled metered consumption: 1%
- Service water: 3%
- Undermetering: 31%
- Leaks on pipes: 12%
- Leaks on connections: 30%
- Leaks on accessories: 23%
Customer inventory – data clarification

Section of the GIS map

- Blue: Has connection and consumption point
- Red: No connection but has consumption point
- Yellow: No connection and no consumption point
- Green: Has connection and no consumption point
Using District Metering Areas (DMAs)

- Monitoring of night flows
- Pipe burst forecast with alarm option
- Measuring the consumption of the selected area
- Noise monitoring
- Monitoring the pressure and the flow of the area
- Scada integration
Designing and realisation of DMAs in Budapest

Flow measuring probe

Data logger and SMS transmitter

Data logger and SMS transmitter
DMA data analysis

- Flow and pressure data of one month

- Flow and pressure data of one day with night minimum flow
Active Leakage Control (ALC) van

Hydrant joints and equipment on the measuring car

Instrument panel
ALC metering method

- Records the water flow per section
- If the flow is high, inspection starts
- Check the suspicious points with valve check microphone
- Localise the failure by correlator
- Check the failure location by ground microphone

Schematic drawing of step test
ALC group has examined 750 km of distribution network and trunk mains altogether.

- **Number of failures found:** 35
- **Saved cubic metres on leaks found:** 585 m$^3$/h/5,200 km
Noise level collector method

- Read out data from data collectors
- Check the recorded noise points
- Check the suspicious points by valve check microphone
- Localise the failure by correlator
- Check the failure location by ground microphone

Location of noise collectors in Castle area
Tasks accomplished in pressure management

• Pressure zone analysis
• On-site visits, exploring critical point (high buildings, industrial facilities with major water demands)
• On-site pressure metering at higher areas
• Hydraulic modelling based on pressure metering results
• Pilot zone (Rákoshegy) designation, in-depth analysis, conciliation
• Pilot zone’s (Rákoshegy) pressure reducer plans, implementation
• Pressure reducer shafts constructed on 6 zones, pressure reduction in operation
Features of sub-zones

Sub-zones with reduced pressure have the following parameters:

<table>
<thead>
<tr>
<th>Name of sub-zone</th>
<th>The size of the reduced area (length of pipes, km)</th>
<th>The ratio of the reduced pressure zone (%)</th>
<th>The pressure of the inlet point (m)</th>
<th>The pressure of the critical point (m)</th>
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<tbody>
<tr>
<td>Rákoshegyi</td>
<td>65,6</td>
<td>34,8</td>
<td>63</td>
<td>21</td>
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<td>Budafoki upper</td>
<td>14,8</td>
<td>16,1</td>
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<td>Budakeszi községi</td>
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<td>45,3</td>
<td>reservoir</td>
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<td>Keletpeste upper</td>
<td>60,3</td>
<td>8,43</td>
<td>33</td>
<td>29</td>
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<tr>
<td>Budafoki lower</td>
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<td>9,7</td>
<td>64</td>
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<tr>
<td>Mátyásföld</td>
<td>71,4</td>
<td>57,8</td>
<td>76</td>
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</table>
Damages on trunk mains

Annual burst rate on trunk mains

- Rákoshegy
- Budafok upper
- Budakeszi
- Keletpest upper
Damage on connections

Connections

Annual burst rate on connections

<table>
<thead>
<tr>
<th>Year</th>
<th>Rákoshegy</th>
<th>Budafok upper</th>
<th>Budakeszi</th>
<th>Keletpest upper</th>
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<td>150</td>
<td>30</td>
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<td>2010</td>
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<td>10</td>
<td>12</td>
<td>8</td>
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<td>2011</td>
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<td>10</td>
<td>5</td>
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<td>2012</td>
<td>90</td>
<td>5</td>
<td>7</td>
<td>5</td>
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<tr>
<td>2013</td>
<td>80</td>
<td>5</td>
<td>7</td>
<td>5</td>
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</table>
Financial and other results

- Total savings from reduction of leakage: 13,500 tHUF/year

- Savings from reduction of pipe bursts: 12,200 tHUF/year

- Further results not quantifiable clearly:
  - Extension of pipe network life
  - Improved water security due to fewer pipe bursts
  - Customer satisfaction due to fewer pipe bursts
The method of Dynamic Cost Comparison Calculations (DCC)

Proper application of DCC in option analysis:
- Leads to the selection of the most cost-effective, optimum solutions!
- Sustainability principle prevails throughout the whole decision-making process!

Main characteristics of DCC:
- Full life cycle approach
- Dynamic approach
- Real term thinking
- Interdisciplinary approach
- Schematization of the calculation process
- In line with national and EU regulations
- Considers all costs! (inv., repl. O&M, res., env.)
Conclusions

- We started leakage activity from the Socialist era.
- We have the same pipe and fitting materials.
- We have tried nearly all of products and solutions in the market.
- We managed to decrease leakage rate from 24% to 16,5%.
- We can keep leakage rate below 17% year by year.

We are ready to cooperate and share our experience!

We have more than 25-year-old experience in the changing environment of distribution network management as a water utility company.
Thank you for your attention!

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