“Incorporating Energy Use into the Economic Level of Leakage Model”

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Objectives

- To develop a dynamic model for the determination of an Economic Level of Leakage considering the energy externalities associated with the four components of water loss management, as developed by IWA, in a water distribution network.

- To develop the methodology for the determination of an Economic Level of Leakage considering the energy externalities in abstraction, treatment, distribution and disposal of water.
Objectives

- To calibrate and test the validity and sensitivity of the developed model.

- To perform the analysis for different strategies for water loss management in Economic Level of Leakage and study their effect on the active leakage control.
A project funded by the European Union (EU), whose overall objective is to apply IWRM concepts for achievement of effective and sustainable urban water schemes in the ‘city of tomorrow’ (i.e. projected 30-50 years from now)

Zaragoza is one of the partner cities for the SWITCH project, and is a demonstration city for the research activities under the Demand Management work package of the project.

http://www.switchurbanwater.eu/
Components of water loss management strategy, as developed by IWA
(Source: Liemberger and Farley, 2004)
Daily Pressure Variation

mH2O

Time
ELL Calculation
Economic Level of Leakage

- ELL is achieved when the marginal benefits of the reduction of water losses are equal to the marginal costs associated with the reduction of water losses.

- The study of the ELL can clarify the fact that other available technologies or approaches to the leakage control would be a better choice for the reduction of leakage.
Economic Level of Leakage

A water utility with enough information about the activities and costs can easily plot the curve. But under a passive leakage control scheme, the common case is to have only one point of the Detection and Repair Cost curve since there is only one value of saved volume and one of cost.
Energy and the Water Industry

The water industry is an intensive user of energy. Energy costs account for over 13% of turnover and the pumping of water uses almost a 80% of the energy invested in treatment process.

After the staff costs, the energy consumption is the second most important expense in the water utilities. And this might be more critical in developing countries.
Energy and the Water Industry

- In the future we’ll have a higher energy use, due to necessity to extract water from new sources as the sea or deep aquifers or to meet higher quality standards.

- The energy consumption is then a function of the water supply and the water network. The increase of energy consumption has an impact in the climate change and calls for a reduction of the carbon footprint and CO2 emissions.
Components of water loss management strategy, as developed by IWA
(Source: Liemberger and Farley, 2004)
Economic Level of Leakage

- Cost of Intervention (CI)
- Variable Cost of Lost Water (CV)
- Rate of Rise of Unreported Leakage (RR)

Can be used to quickly assess the Short Run ELL for any size of system or sub-system.
## Economic Level of Leakage

<table>
<thead>
<tr>
<th>Item</th>
<th>Unreported Annual Real Losses</th>
<th>Reported Losses + Technical Losses</th>
<th>Real Losses</th>
<th>Cost of Water Losses</th>
<th>Survey cost</th>
<th>Total cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Units</td>
<td>(m3x1000/year)</td>
<td>(m3x1000/year)</td>
<td>(m3x1000/year)</td>
<td>(1000£)</td>
<td>(1000£)</td>
<td>(1000£)</td>
</tr>
<tr>
<td>Description</td>
<td>The Unreported Annual Real Losses are calculated using the RR and the length of mains during the amount of time the analysis is done.</td>
<td>Mains and Service Reservoir Leakage + Reported Burst Volume in Distribution Mains and Service Connections + Estimated Background Leakage if ICF = 1</td>
<td>Unreported Annual Real Losses + Reported Losses + Technical Losses</td>
<td>Annual Budget for Interventions X Economic Unreported Real Losses/ Unreported Annual Real Losses</td>
<td>Cost of one 'whole system' intervention (Excluding cost of repairs)</td>
<td></td>
</tr>
</tbody>
</table>
Energy Externalities

In this research we’ll focus in the following items:

- Fuel used in active leak detection, leak repair and pressure management.
- Electricity used in active leak detection, leak repair, pressure management.
The value of emissions from the use of labour are estimated to be approximately 1 kgCO2e/person/hour (UKWIR, 2008).

The usual setup for leak control work involves one van and 4 persons. So the value of emissions for this setup will be 32 kgCO2e per day or 6944 kgCO2e per year + the amount of emission related to the distance travelled for repair.
Energy Externalities

- A total of 7226.88 km were driven by various vehicles for work on leakage control.

- Considering a value of 0.210 kgCO2/km recommended by the UKWIR we obtain 1518 kgCO2e for the vehicle emissions for leakage control activities during 2009 in Zaragoza.
Thank you

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