Energy Efficiency in the MENA Water Sector: Pumping Water

Paper 6

Effects of Water Network Losses on Energy Saving

Written by:
Sayed El-Beltagy

Developed under the guidance of the ACWUA Energy Efficiency Task Force, with support from GIZ ACWUA WANT program 2013-2015
# Table of Contents

1. Background/Situation ................................................................. 3
2. Objectives ...................................................................... 3
3. Approach ........................................................................ 4
4. Leakage Detection Methodology .................................................. 4
5. Activities & Achieved Results ...................................................... 5
6. Activities of Nasr City Pilot Area .................................................. 6
7. Flow Meters and Pressure Loggers ................................................ 7
8. Flow Results (Before & After Repair) ................................................. 7
9. Leaks Detected and Repaired ....................................................... 8
10. Results and Benefits ................................................................ 10
11. Good Practice ....................................................................... 10
12. The Problem ......................................................................... 10
13. Flow Measurements (Beginning & End) ........................................ 11
14. Leaks Repair & Flow Measurements ............................................ 12
15. Impact on the Plant ................................................................ 13
16. Summary and Results .............................................................. 14
17. Conclusion .......................................................................... 14
Background/Situation

- Losses of water are not only the loss of water but also loss of energy and money.
- The World Bank estimates the annual volume of non revenue water (NRW) in developing countries to be in the range of 26.7 billion m³, representing about 5.9 billion USD lost by water utilities every year.
- There is a close relationship between losses in water distribution networks and the energy consumed inside the plant to produce the required quantity of water.
- For example, if we assume that there is a loss in water networks estimated by 50% of the water produced from the WTP it means that we need to double the production of the WTP by increasing the operating hours that lead to double the consumptions of (electricity – chemicals operators) and decrease the lifespan of the motors and pumps.
- So, it was necessary to control physical leakage in order to rationalize the consumption of electricity in WTP.

Objectives

- The ultimate objective is to reduce the rate of electricity consumption for the cubic meter (m³) produced.
- We aimed to reduce the physical leakage in drinking water systems which is estimated in Egypt about (30-40%) to reach the international accepted limits.
Approach

- HCWW has established departments to reduce losses of the drinking water networks in all affiliated companies.
- HCWW has provided the AC’s with the newest technology devices to detect leaks in all diameters and materials of pipes.

- Technicians have been trained on using leak detection devices.
- Business Plan has been prepared to scan all drinking water networks based on available devices and technicians.

Leakage Detection Methodology

- Using networks map from geographic information systems (GIS)
- Dividing networks into zones (DMA)
- Measuring pressure and flow by using ultrasonic flow meters;
- Installing Noise Loggers on valves to define the suspicion points;
- Limitation of leak points using correlator device;
- Confirmation of leak points using Ground Microphone / Listening stick;
- Repairing leaks;
- Measuring pressure and flow after repairing leaks
- Calculating the amount of saved water after repairing
- Repeating these steps to ensure that there are only minimal leaks.
Activities & Achieved Results

- There are many activities and pilot areas have been implemented such as (Nasr City - Alexandria - Tanta - etc ……).

<table>
<thead>
<tr>
<th>Pilot Area</th>
<th>Losses Before (%)</th>
<th>Losses After (%)</th>
<th>Egyptian Cooperation with</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nasr City</td>
<td>47%</td>
<td>35%</td>
<td>Italian environmental ministry</td>
</tr>
<tr>
<td>Alexandria</td>
<td>50%</td>
<td>36%</td>
<td>Germany</td>
</tr>
<tr>
<td></td>
<td>35%-21%</td>
<td>21%-15% (all)</td>
<td></td>
</tr>
<tr>
<td>2-Abukier</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tanta</td>
<td>23%</td>
<td>18%</td>
<td>Italian environmental ministry</td>
</tr>
<tr>
<td>Sharkia</td>
<td>26.5%</td>
<td>9.3%</td>
<td>Japan</td>
</tr>
</tbody>
</table>
Activities of Nasr City Pilot Area
Flow Meters and Pressure Loggers

Flow Measurement (Bevor & After Repair)

Total flow = 5790.38 + 3564.46 = 9354.84 m³/day

F1 & F2 = flow
Leaks Detected and Repaired

11 Leaks found (3 Hydrants, 1 Valve, 1 Pipe, 6 Service connections)
Flow Measurement after Repair Leakage

Flow Results (Before & After Repair)

Recovered water after repair leaks = 9354.84 - 6960.71 = 3294.13 m³/day
Results and Benefits

- Recovered Water = 3.294 m$^3$/day
- From the performance indicators of the WTP that feed this pilot, we found that the consumption of electricity to produce 1 cubic meter of water is about 382 Watts in the period of working.
- So we recovered exactly $3.294 \times 382 = 1258.4$ KW/day.
- The water networks pressure improved as a result of reducing leakage leading to reduce boosters operating hours.
- This amount of energy saved from a pilot area of approximately 10 km length network with pipes of different diameters.

Good Practice

Another Pilot Area (Port Said Pipe Line)

- The great achievements of Leak detection department appear in solving major problems that may be lead to spend additional funds to compensate loss.

The Problem

- The produced water which is coming from the ADLIAA WTP to feed some villages in the south of Port Said is not enough.
- By measuring the outflow of the WTP we found that it was about 260 l/s, and in the same time we measured at the end point on the carrier line before entering Port Said which was about 67 l/s.
- Accordingly, it was agreed to increase the number of operating hours through additional pump to compensate the suitable quantity required for south of Port Said.
- Knowing that by operating additional pump, the consumption of energy, electricity is increased to about the double as well as the additional investment costs.
- This proposal has been delayed until full scan of the carrier pipe line of length about 35 km and 600 mm diameter by using the leak detection instruments.
- By the end of scanning works we detected 8 Leaks in the carrier pipe line.
- These leaks have been repaired and the flow was measured again in the same end point, we found that the reading increased to 170 l/s by recovering approximately 100 l/s.
The measurement reading at the beginning of the pipe line was about 260 l/s.

The measurement reading at the end point of the carrier line was about 70 l/s.
Sayed El-Beltagy: Effects of Water Network Losses on Energy Saving

Measuring & Repairing Leaks photos

The measurement reading at the end point of the carrier line after repairing was about 170 l/s.

![Image of measurement reading](image-url)
Impact on the plant

The above tables & curves show that the rate of electricity consumption for the cubic meter (m³) produced has decreased after repairing leaks detected in a pipeline before the WTP in the second half of the fiscal year 2013/2014.
The Summary

Results

- We saved adding new pump to compensate the losses of water.
- Recover water losses of about 100 L/s or 360 m³/h from the performance indicators in the above table and the cost of producing one cubic meter of water is about 386 watts of electricity which means that the saving was about 139 kW/h (more than 3,335 kW/day)
- Saving more than 50% of the chemicals consumed.
- Avoiding the damage of infrastructure and extending the life span of assets.

Conclusion

- As described in title of my article that there is a close relationship between loss reduction in water networks and energy saving in WTP represented in decreasing electricity consumption whereas the saving in Nasr City pilot area was 1260 kW/day in the water and the saving in networks was 3294 m³/day as a result of repairing some leaks.
- Also we saved 8640 m³/day of water pipeline that feed south of Port Said that led to save about 3335 kW/day from electricity consumption in Adliaa WTP shown in the rate of consumption (Watt/m³) that decreased from 418 Watt/m³ to 310 Watt/m³.......