Evaluating energy recovery potential in Murcia's water supply system

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Abstract

Murcia is the 7th most populated city in Spain. Its water supply system is extensively monitored through a large number of pressure gauges and flow meters. Murcia's water supply network is fed from distribution reservoirs at enough elevation to avoid needing pumping stations for most of the city districts. Hydraulic resources have been evaluated throughout the water supply system. Besides the pressure reducing valves, where the assessment is quite straight forward [1], District Metered Areas (DMA) inlets have been evaluated. In these areas despite the hydraulic resources are not as great as in pressure reducing valves locations, their location is quite convenient. Actually, these positions are located inside the city, therefore making easy to use the produced energy in municipal self consumption or to provide facilities to the citizens.

In order to perform such evaluation, a detailed model of the water supply network has been implemented in EPANET parting from a GIS model. The first step of the evaluation has consisted in the optimizing and validation of the model. Initially, the model was reviewed by comparing pressure and flow rate measurements in the main pipes. Then, an extensive experimental campaign was designed. In that campaign valves were switched so that each day a set of District Metered Areas (DMA) have just one metered inlet or at the most a very short number of metered inlets, whereas having a set of pressure measurements within the DMA. The obtained data was used to minimize errors in pressure time series, optimising roughness of the main pipes through Levenberg/Marquardt BFGS algorithm using EPANET ToolKit through Epanet-Octave [2]. Important roughness proposed changes tended to be located surrounding particular points, where errors in the GIS were located (mainly wrong diameter assignement). After patching all the errors the algorithm eased to localise, model errors were mostly below measures uncertainty, and therefore, the model was considered validated.

Then, the hydraulic potential at the DMAs inlets has been evaluated by tracking the "instantaneous" minimum pressure and head within each DMA, as well as the flow rate entering the DMA. So that, the maximum head and the range of flow rates is established for the turbine.

At the moment, once that all of these potentials have been assessed, a turbine prototype is being designed.

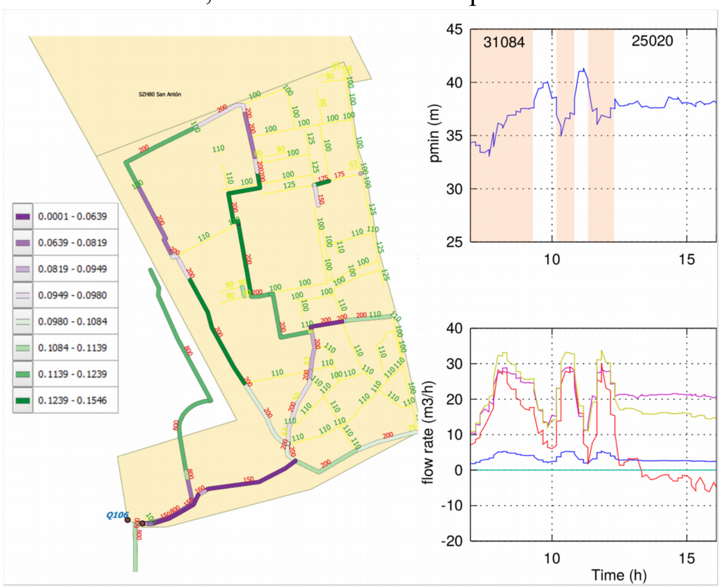

Figure 1: At the left of the figure the optimal roughness of the main pipes within a DMA corresponding to the first step of validation is shown. At the top on the right of the figure the instantaneous minimal pressure in a DMA is represented showing the ID of the corresponding node, whereas at the bottom the flow rate entering the DMA is shown.

References

[1] Coelho, B., & Andrade-Campos, A. (2014). Efficiency achievement in water supply systems—A review. Renewable and Sustainable Energy Reviews, 30, 59-84.

[2] Vigueras-Rodríguez, A., et al. (2016). Evaluation of Leakages Effects in the Water Supply System of Moratalla. Danish Water Forum 2017.

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