Accepted Manuscript

Optimal design of water supply networks using an energy recovery approach

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PII: S0960-1481(17)31042-X

DOI: 10.1016/j.renene.2017.10.080

Reference: RENE 9368

To appear in: Renewable Energy

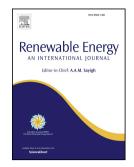
Received Date: 13 May 2017

Revised Date: 10 October 2017

Accepted Date: 23 October 2017

Please cite this article as: Meirelles Lima G, Brentan BM, Luvizotto Jr. E, Optimal design of water supply networks using an energy recovery approach, *Renewable Energy* (2017), doi: 10.1016/j.renene.2017.10.080.

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| | ACCEPTED MANUSCRIPT |
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| 1 | OPTIMAL DESIGN OF WATER SUPPLY NETWORKS USING AN ENERGY |
| 2 | RECOVERY APPROACH |
| 3 | |
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| 17 | ABSTRACT: Water Distribution Networks (WDNs) represent a major investment for |
| 18 | water supply systems development. The standard procedure for their design is to search |
| 19 | for the minimum cost, which is produced by the smaller diameters capable of |
| 20 | maintaining the minimum required pressure. However, some District Metered Areas |
| 21 | (DMAs) have a significant topographic elevation difference, and even if the minimum |
| 22 | diameters are reached, the pressure remains high, and a Pressure Reducing Valve (PRV) |
| 23 | is necessary. However, if the pipe diameters of the network are increased, distributed |
| 24 | headloss will be reduced, and this additional energy will be locally dissipated in PRVs |
| 25 | to maintain the pressure in the DMA below the maximum allowed value. If a turbine is |
| 26 | installed instead, the dissipated energy can be used, creating a benefit that can justify the |
| 27 | additional investment due to the diameter increment. Therefore, this paper presents a |
| 28 | method for the optimal design of a WDN considering energy recovery. The use of |
| 29 | Pumps as Turbines (PATs) is considered for energy production. The optimal design is |
| 30 | obtained using a two-level optimization procedure: the first is used to obtain pipe |
| 31 | diameters, and the second is used for PAT selection. Particle Swarm Optimization is |
| 32 | used, and two case studies are presented. |
| 33 | |
| | |

34 KEYWORDS: Water distribution networks, pumps as turbines, energy recovery,
35 energy efficiency, optimization.

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