Managing water pressure for water savings in developing countries

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ABSTRACT

Many water utilities, particularly in the developing countries, continue to operate inefficient water distribution systems (WDSs) with a significant amount of water and revenue losses. Various factors, manageable to different extents, contribute to water losses, such as poor infrastructure, high pressures, illegal water use, etc. Whilst the problem of water losses in WDSs is global in scale, solutions need to be tailored to local circumstances due to the various causes of water loss and the mechanisms available to manage them. This paper investigates the potentials of the available pressure management methodologies and their implementation in developing countries, using a case study of a district metering area (DMA) in Kotež-Serbia. The minimal night flow method was applied for assessment of real losses. A particular focus is on assessment of water savings due to reduction of pressures. A total of three methods for estimation of water savings are described and tested against data measured in the DMA under initial and reduced pressures: (i) the method based on Leakage Index (*LI*) calculations, (ii) the PRESMAC model and (iii) a newly-developed method which is based on the assumption that both leakage and consumption are pressure dependent. The results indicate that the third method leads to the most accurate prediction of the total amount of water savings under reduced pressures, with only 6% difference between measured and estimated volume of saved water.

Keywords: water supply, water losses, minimum night flow, pressure, consumption, water savings

INTRODUCTION

Water utilities in developing countries are putting significant effort into providing customers with a reliable level of service, often via poor water distribution infrastructure and restricted budgets. There are many factors contributing to water losses in water distribution systems (WDS), such as: ageing infrastructure, high pressures, external and internal pipeline corrosion, service tank overflows, poorly designed and constructed WDSs, metering errors, illegal use and poor operation and maintenance practices. Understanding the condition and operation of the WDS is a key factor in minimising water losses.

Although regular pipeline inspection seems like an ideal direct method, it is costly and unaffordable for many water companies in developing countries. Alternative indirect assessment of water distribution systems based on the water balance and performance indicators seem to be more practical. The International Water Association (IWA) has developed a standard water balance methodology and an array of performance indicators for benchmarking of water utilities regarding water losses (Alegre et al., 2006). Due to large discrepancies in WDSs development, network data availability and reliability of monitoring data, operation practices, available water loss management methodologies used in developed countries often cannot be directly applied to the utilities in developing countries.

The efficiency of WDSs is measured by the difference between WDS input volume and water delivered to customers and billed (revenue water), commonly referred to as non-revenue water (NRW). NRW consists of water losses (real and apparent losses) and authorised unbilled consumption (such as water for fire fighting and pipeline flushing). Real losses include tank overflows and leakage on mains, distribution network and service connections, while apparent losses consist of unauthorised consumption and metering inaccuracies. The quantity of water lost is a measure of the operational efficiency of a WDS. High levels of water losses are an indication of poor governance and poor physical condition of the WDS (Mutikanga, 2012).

Water and revenue losses are a major problem for water utilities worldwide. The amount of water lost from WDSs is astounding – NRW from WDSs worldwide is estimated at 48 billion m^3 per year (Kingdom et al., 2006). The same report indicates that about 55% of the global NRW by volume occurs in the developing countries. Large discrepancies in NRWs are noticeable even in the developed countries. The lowest leakage levels are reported in the Netherlands (3–7%), while in most developed countries these figures are higher: 15% in USA, 13.8% in Canada, 42% in Italy and 34.9% in Greece (Mutikanga, 2012). Reported NRW amounts in the 12 largest cities in Serbia are in the range of 27% (in Leskovac) to 67.80% (in Lazarevac). Due to insufficient data available from the local water utilities, reported values of NRW in Serbia are obtained from restricted calculations based only on the total volume of water abstracted and the total authorised volume of water used (Topalovic et al., 2012).

Even though the problem of water losses in WDS is global, solutions need to be tailored to local circumstances due to variation in the causes of water losses and the mechanisms available to manage them. For instance, in developing countries, apparent losses often represent a very significant portion of total losses, while in developed countries, physical losses are by far the highest loss factor.

Reduction of pressures within the whole or part of the WDS is one of most efficient and most frequently applied methods for reducing leakage (Fantozzi and Lambert, 2008). The influence of pressure reduction on reduction of leakage is

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