Development of Multiple-Leakage Detection Approach for Water Distribution Networks

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(a) Purpose of study or research hypothesis

The purpose of this study is to develop a multiple-leakage detection approach using hydraulic analysis and various observational data of water distribution network (WDN) for effort-saving process.

(b) Key issue(s) or problem(s) addressed

It is more difficult and time consuming to detect leakage than breakage, and if the water leaks continue, the water supply rate is lowered, resulting in economic loss and inconvenience to users. Therefore, it is necessary to identify leak points quickly and replace or repair the damages. The direct detection approaches by technicians using equipment are accurate but take a long time and efforts. In this study, we propose a fast and efficient multiple-leakage detection approach using various field data of the system and hydraulic analysis schemes.

(c) Methodology or approach used

The proposed approach uses observational data, such as the pressure and flow rate, in conjunction with an optimization method (Genetic Algorithm) and hydraulic analysis simulations, to improve detection efficiency for multiple leaks in the field. The proposed multiple-leak detection approach was developed as a computer model which is based on MATLAB (version R2020a) in conjunction with EPANET. EPANET is utilized for the WDN hydraulic analysis, and MATLAB is employed for simulation, such as selection of pipes with potential leaks using an optimization method and simulation of the cooperation between the analysis and fieldwork teams.

(d) Results or conclusions derived from the project

The proposed methods are applied to a real WDN (a DMA-scale) with installed multiple pressure loggers and a flow meter. Under an earthquake scenario inducing multiple-leaks, field data of pressures and flows are collected and the proposed methods are applied for the leak detection. Each proposed method is compared and analyzed by estimating the leak detection efficiency, which are measured as the number of searched pipes and the time spent to detect all the leaks.

(e) Implications of the project relevant to congress themes

In general, leak detection is a time- and cost-consuming process. Here, we propose the computer-based multi-leakage detection methods that can be used for quick and efficient recovery of WDN in case of large-scale disasters, such as earthquake and flood.