Optimal Replacement Scheduling of Water Pipelines

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Abstract

Water distribution networks (WDNs) are designed to satisfy water requirement of an urban community. One of the central issues in human history is providing sufficient quality and quantity of water through WDNs. A WDN consists of a great number of pipelines with different ages, lengths, materials, and sizes in varying degrees of deterioration. The available annual budget for rehabilitation of these infrastructures only covers part of the network; thus it is important to manage the limited budget in the most cost-effective manner. In this study, a novel pipe replacement scheduling approach is proposed in order to smooth the annual investment time series based on a life cycle cost assessment. The proposed approach is applied to a real WDN currently operating in South Korea. The proposed scheduling plan considers both the annual budget limitation and the optimum investment on pipes' useful life. A non-dominated sorting genetic algorithm is used to solve a multi-objective optimization problem. Three decision-making objectives, including the minimum imposed LCC of the network, the minimum standard deviation of annual cost, and the minimum average age of the network, are considered to find optimal pipe replacement planning over long-term time period. The results indicate that the proposed scheduling structure provides efficient and cost-effective rehabilitation management of water network with consistent annual budget.

Keywords : life cycle cost, multiobjective optimization, pipe replacement scheduling, smoothing investment

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