A water supply risk assessment model for water distribution network

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ABSTRACT

A water supply risk (WSR) assessment model was developed for a water distribution network and applied in a targeted area for determining the pipe burst probability (ProbPB), the impact of pipe burst (ImpPB), and the WSR calculated as the product of these two values. ImpPB was separately calculated for the leakage duration time and the repair work time when water service is cut-off or reduced. The WSR for the block in the study area was calculated at 1.507 m³/year. To verify this WSR, pipe replacement was performed based on ProbPB, which is a management indicator for the water provider, ImpPB, which is a management indicator for the water consumer, and the WSR that considers both of these, by analyzing the WSR reduction effect of each. The pipe replacement cost, which is a restrictive condition, was set at 5% of the full replacement cost (5.3 billion won) for the entire pipe network in the targeted area. Pipe replacement was performed based on ProbPB, ImpPB and WSR. The block WSR reduction efficiency for pipe replacement was calculated at 0.524 m³/year/billion won based solely on ProbPB, 2.163 m³/year/billion won based solely on ImpPB, and 2.173 m³/year/billion won based on concurrent consideration of both factors by introducing the concept of WSR. Hence, the reduction efficiency was the highest for pipe replacement based on WSR. The study results demonstrated the capability of the proposed WSR assessment model to concurrently consider the positions of both water provider and water consumer. In addition, the cost effectiveness of the model was verified.

Keywords: Water supply risk; Pipe burst probability; Impact of pipe burst; Logistic regression analysis; ISM

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