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Modelling, Assessment, and Optimisation of Rules for Selected Umgeni Water Distribution Systems

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Abstract : Umgeni Water is a water board that supplies most parts of KwaZulu Natal with bulk portable water. Currently, Umgeni Water is running its distribution system based on required reservoir levels and demands and does not consider the energy cost at different times of the day, number of pump switches, and background leakages. Including these constraints can reduce operational cost, energy usage, leakages, and increase performance. Optimising pump schedules can reduce energy usage and costs while adhering to hydraulic and operational constraints. Umgeni Water has installed an online hydraulic software, WaterNet Advisor, that allows running different operational scenarios prior to implementation in order to optimise the distribution system. This study will investigate operation scenarios using optimisation techniques and WaterNet Advisor for a local water distribution system. Based on studies reported in the literature, introducing pump scheduling optimisation can reduce energy usage by approximately 30% without any change in infrastructure. Including tariff structures in an optimisation problem can reduce pumping costs by 15%, while including leakages decreases cost by 10%, and pressure drop in the system can be up to 12 m. Genetical optimisation algorithms are widely used due to their ability to solve nonlinear, non-convex, and mixed-integer problems. Other methods such as branch and bound linear programming have also been successfully used. A suitable optimisation method will be chosen based on its efficiency. The objective of the study is to reduce energy usage, operational cost, and leakages, and the feasibility of optimal solution will be checked using the Waternet Advisor. This study will provide an overview of the optimisation of hydraulic networks and progress made to date in multi-objective optimisation for a selected sub-system operated by Umgeni Water.

Keywords : energy usage, pump scheduling, WaterNet Advisor, leakages
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