A Multi-Objective Multi-Period Model for Multiple Contaminant Wastewater Reuse Networks with Regeneration Units and Fuzzy Approach

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Abstract

In the field of environmental research, freshwater conservation is presently one of the advancing topics since this is considered as one of the scarce resources at present. This study addresses the need to build a mathematical model for a multiple contaminant wastewater regeneration network (WWRN) under a long-term planning horizon. Fuzzy programming was also used due to uncertainty on the inlet concentration levels of processes and treatment facilities. A Mixed Integer Non-Linear Problem (MINLP) was formulated with freshwater sources, process units, treatment facilities and disposal sites as the nodes. Amount of water flow to allocate, piping connections, choice of material and opening or closing a treatment facility are the decisions made by the model. The model has several objective functions which include minimizing overall cost, minimizing freshwater usage, maximizing reliability and maximizing aspiration level. A heuristic was developed to obtain a logical procedure on how to solve the multiple objectives. For the network's structure, the number of pipes used as well as the number of treatment facilities opened is also analyzed.