The Optimization-Based Design and Synthesis of Water Network for Water Management in an Industrial Process: Refinery Effluent Treatment Plant - DTU Orbit (08/11/2017)

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The increasing awareness of the sustainability of water resources has become an important issue. Many process industries contribute to high water consumption and wastewater generation. Problems in industrial water management include the processing of complex contaminants in wastewater, selection of wastewater treatment technologies, as well as water allocation, limited reuse, and recycling strategies. Therefore, a water and wastewater treatment network design requires the integration of both economic and environmental perspectives. The aim of this work was to modify and develop a generic model-based synthesis process for a water/wastewater treatment network design problem utilizing the framework of Quaglia et al. (2013) in order to effectively design, synthesize, and optimize an industrial water management problem using different scenarios (both existing and retrofit system design). The model-based mathematical problem was formulated as mixed integer linear (MILP) and mixed integer non-linear programming (MINLP) and strived to identify the best wastewater treatment processes among a set of predefined alternatives that produce a minimum total annualized cost, while meeting all wastewater specification criteria. In addition, the effluent options (for different retrofit scenarios) in the modified superstructure could be set as discharge only, zero liquid discharge (total recycling), or a combination of recycling and discharge with the aim of minimizing the amount of fresh process water consumption through the recycling of treated wastewater. Also, an industrial case study of a refinery wastewater treatment plant was implemented. Alternative recycling schemes (retrofit design problem) were proposed and solved. The retrofit design solution using developed generic model-based synthesis offered a preliminary guideline for a better wastewater treatment network in terms of economic benefits and environmental impact compared to the existing process and accomplished it in an effective time frame.

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