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Optimal Allocation of Shared Resources in an Integrated Sugar Production Plant

by

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The evaporation and crystallization sections in a sugar refinery represent complex, energy-intensive processes; therefore any improvement in the rate of usage of fresh steam has significant impact on its economy. Previous works have been reported concerning to the implementation of control strategies in the crystallization process, as well as the development of optimization algorithms to produce sugar crystals with a desired quality. However, there is a lack of information related to energy usage minimization for the system evaporation-crystallization as a whole. In this work, a holistic approach of the integrated operation of both sections is considered. The objective is to minimize the rate of fresh steam consumption and its variation, while different process constraints are satisfied. The employed model corresponds to the sugar benchmark of the EU-funded project Highly-complex and Networked Control Systems (HYCON2), which has been implemented in gPROMS. Then, optimal profiles in selected manipulated variables have been determined by control vector parameterization, resulting in significant savings in the amount of fresh steam to the process. However, as is shown, the implementation of this solution can produce violations of constraints in the level of the buffer tanks in a long term. To overcome this problem two strategies are proposed and implemented, including modification of the logic control of the crystallizer and the use of a hierarchical control structure. With this proposal it was possible to ensure the operation of the plant in the long term. Finally, the applicability of a coordinator in the process is discussed, which serves as motivation for future works.