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Abstract

Advanced Approach for model-based Scheduling of the Gasoline Production Line of Refineries

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Increasingly globalised markets put pressure on refineries to optimize their internal production processes in order to remain competitive. In this situation computer-aided optimisation of scheduling of gasoline production seems to be a promising way to contribute to a refinery's profitability due to large achievable economical benefits, smoother plant operations and reduced lead-times for customer orders.

This work is extending and improving a concept for computer-aided scheduling of gasoline blending processes that has been presented in a preceding thesis. The applied solution concept is based on decomposition of the original MINLP scheduling problem in a Non-Linear Programming (NLP) sub-problem and a Mixed-Integer-Linear-Programming (MILP) sub-problem, which are solved separately.

Main features of the extended concept are:

- In order to access additional potential for optimisation, the respective concept has been extended to take into account not only blending processes but also conversion, separation and mixing processes occurring in the so-called gasoline production upstream units, which are used to produce gasoline blending components.
- Due to the introduction of additional process unit models, the NLP-problems that have to be solved using the proposed solution concept can become too complex to solve. Because of this reason, a horizontal decomposition and coordination method for the respective large-scale NLP-problems has been developed to decompose the respective NLP-problems into smaller sub-problems.
- Generally, changing modes of operation of the gasoline production line upstream units lead to varying properties of gasoline blending components. The consideration of varying properties in optimisation problems involving blending processes can lead to non-convex bilinear problem formulations. In order to consider these aspects in MILP-problems as part of the used solution concept, a novel model formulation has been developed to avoid the occurrence of bilinear terms and to allow for the solution of the respective optimisation problems to global optimality.

The stated concept has been prototypically implemented by using commercially available solvers. In order to proof its applicability, the developed concept has been successfully applied in a number of case-studies to model and optimize scheduling of gasoline production of a real-world refinery.

Due to its modular nature, the developed concept is also applicable to optimize scheduling in other refinery areas and forms the basis for a commercial software solution for refinery scheduling distributed by the Siemens AG, Germany. Furthermore, a patent has been granted for the developed approach.