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Production Planning for Multi-site Batch Plants with the MILP Method

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Production planning for multi-site batch plants to maximize total profits should establish simultaneous allocations to the plants considering available production times and transportation of products from the plants to the distribution centers. Since some intermediate products of batch plants are unstable, combining products often reduces the cycle times. Therefore, production sequences are required to estimate production times, but production sequences depend upon allocation, which cannot be determined without estimation of production times. A straightforward mathematical formulation for such production planning results in a mixed-integer non-linear programming (MINLP) problem, which may require excessive computational time even for small problems. Optimal production planning requires that allocations for each batch plant are produced based on product combinations (product mixes), of which only the productivities are improved. This study introduced product mixes as the units of allocation. The method of allocation is to determine the optimal numbers of individual product mixes for each batch plant. Cycle times of product mixes are constant, so the required production time at each plant may be approximated as the sum of the cycle times of product mixes. Based on product mixes with predetermined cycle times, manufacturing costs, and transportation costs, the mixed-integer linear programming (MILP) problem is solvable and can simultaneously establish the allocation and the transportation of products with maximum total profits. The effectiveness of this proposal is demonstrated through an example problem.

Keywords: Production planning, Batch plant, Product mix, MILP

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