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Mathematical programming-based approaches for multi-facility glass container production planning

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Abstract

This paper introduces a mathematical model (together with a relaxed version) and solution approaches for the multi-facility glass container production planning (MF-GCPP) problem. The glass container industry covers the production of glass packaging (bottle and jars), where a glass paste is continuously distributed to a set of parallel molding machines that shape the finished products. Each facility has a set of furnaces where the glass paste is produced in order to meet the demand. Furthermore, final product transfers between facilities are allowed to face demand. The objectives include meeting demand, minimizing inventory investment and transportation costs, as well as maximizing the utilization of the production facilities. A novel mixed integer programming formulation is introduced for MF-GCPP and solution approaches applying heuristics and meta-heuristics based on mathematical programming are developed. A multi-population genetic algorithm defines for each individual the partitions of the search space to be optimized by the MIP solver. A variant of the fix-and-optimize improvement heuristic is also introduced. The computational tests are carried on instances generated from real-world data provided by a glass container company. The results show that the proposed methods return competitive results for smaller instances, comparing to an exact solver method. In larger instances, the proposed methods are able to return high quality solutions.

1. Introduction

European economy has recently experienced a serious crisis, which has led to implications that threaten an in-depth change in both manufacturing and retail structures. Companies have continued to develop cost cutting projects with their major customers, intervening jointly in the value chain, improving their competitiveness and reducing the time-to-market even further.

Top priority has been given to customer needs, not only through innovation, but also by providing a flexible and fast response to their needs facing unstable consumption patterns in the economy. Companies have been fine-tuning their planning and logistics organization in order to fully meet the new requirements of customers.

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