International Conference
on Industrial Engineering and Systems Management

IESM' 2009

May 13 - 15, 2009

MONTREAL - CANADA

A modified branch-and-bound algorithm for production planning in steel rolling mills

Rami As'ad[a] and Kudret Demirli [a,*]

[a] Fuzzy systems research laboratory
Department of Mechanical and Industrial Engineering
Concordia University, 1515 St. Catherine W., Montreal, PQ, H3G 1M8, Canada
*Email: demirli@alcor.concordia.ca

Abstract

In this paper, we address an application of the dynamic capacitated multi-item lot sizing problem in a steel rolling plant. Although it stands as one of the essential industries contributing to a nation's economy and pace of development, the steel industry has not received as much attention in the literature as opposed to many other industries. Through incorporating the various technological constraints associated with the manufacturing process, the integrated production–inventory problem is formulated as a mixed integer bilinear program (MIBLP). The paper also presents a branch and bound based algorithm that exploits the special structure of the mathematical model to minimize the number of branches and obtain the bound at each node. The developed algorithm guarantees convergence to the optimal solution through performing implicit enumeration of all feasible solutions. The use of the developed algorithm is illustrated using a numerical example for a small problem instance.

Keywords: Inventory, steel mills, demand substitution

1 Introduction

Due to the ever-increasing level of competitiveness and the newly emerging production control techniques, industrial enterprises are forced to revise their strategies continuously and further optimize their operational processes accordingly. The iron and steel industry, for instance, is characterized by being both capital and energy intensive and, as such, the importance of effective production planning in such industry is by no means less than that for any other industry. The optimization of production and inventory related decisions in steel plants poses as a great potential for cutting down on the expenses associated with energy consumption and capital investments. Needless to say, the steel manufacturing represents one of the backbone industries greatly affecting a nation's economic growth and pace of development. Nowadays, a substantial portion of the indispensable products that are used on a daily basis and serve multiple purposes have steel ingredient in them in one form or another, ranging from complicated high-tech products such as cars and airplanes, to much simpler ones such as kitchen utensils. In North America alone, more than 100 million tons of steel are produced annually with an estimated value of over 50 billion dollars [8].