A surplus rectangle fill algorithm for petrochemical industry area-wide layout optimization with key plant constraint

H. Zhao¹, Y. Wang*,², X. Feng³

¹China University of Petroleum (Beijing), China
²China University of Petroleum, China
³Xi'an Jiaotong University, China

Abstract

Plant layout is an important and long term field in industrial research and practice, which can reduce capital cost, shorten production time and increase productivity. At present, most researchers studied on the layout design of facilities in a plant but not plants in an area. Industrial area-wide layout problem is more complex. The relationship between plants and the conditions around the industrial area have a significant impact on area-wide layout design, but few researchers considered these aspects. A plant is a basic production unit in the petrochemical industrial area. There are many material connections between plants. Besides, the land cost accounts for a large proportion of the total investment cost. A new methodology is proposed in this study to consider both aspects. The objective function of the proposed mathematical model is shown below to minimize the total cost. The model can be used in industrial conditions, transport conditions and other factors. The surplus rectangle fill algorithm can optimize the area-wide layout design while considering the natural conditions and other factors. In this paper, considering the effect of the natural conditions, the transport conditions and other factors, a new methodology is proposed to solve this problem. The objective of the mathematical model is to minimize the land cost and piping cost. In this methodology, each plant is simplified as a rectangle with fixed area, which can be placed horizontally or vertically. In addition, some plants are considered as key plants whose aspect ratios are adjusted to optimize the layout while their areas are constant. Considering the requirement for the natural conditions, transport conditions and other factors around the industrial area, the surplus rectangle fill algorithm and genetic algorithm are combined to optimize the problem. A case study is described to demonstrate the effectiveness of the proposed methodology.