Optimal Model of Port Gathering and Distribution Network Based on Bi-level Programming Approach

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Abstract

With the rapid development of international trade, the contradiction between the increasing demand for container transportion and the backward port collection and distribution system has become more and more prominent. The optimization of container port collection and distribution network has become the focus of domestic and foreign scholars. At the same time, under the background of low-carbon economy, how to reduce the environmental pollution in the process of collection and distribution is also an urgent problem to be solved. To improve the rationality of site selection and distribution of transfer stations in port gathering and distribution network and optimize the distribution of cargo flow, the influence of carbon emissions and multi-cargo owners' preference factors on port gathering and distribution network was considered. A two-level programming model was established to describe the relationship between site selection and distribution decision and shippers' preference behavior. The cost of carbon emissions was added into the upper decision-making. The UE distribution model considering shippers' preference was established in the lower model, which was used to estimate the equilibrium cargo flow of each section in the transportation network. According to the characteristics of the model, a heuristic algorithm based on genetic framework and Frank-Wolfe algorithm was designed, and the validity of the model and algorithm was verified by case analysis. Finally, the effectiveness of the model are verified by a case study of 26 nodes in Qingdao port's collection and distribution system. The results show that considering the cost of carbon emissions in the model can effectively affect the air pollution of the port distribution network. The location layout and cargo flow distribution of container transfer stations can be optimized by considering the preference of multiple cargo owners.

Keywords

Port Gathering and Distribution Network, Carbon Emissions, Shippers' Preference, Bi-level Programming Model