

The problem of multi-compartment vehicle routing for the collection and transport of waste

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Introduction

Waste management is a multi-disciplinary activity that includes the collection of waste from residential, commercial, institutional ... (houses, companies, offices ...), transportation, treatment, recovery, and finally the elimination. In general, collection and transportation is the most important and costly aspect of the process due to the large number of sources and the random use of vehicles in the collection and transportation process.

In fact, there is more than one way to collect solid waste: waste collectors start the journey from a collection centre for collection of segregated waste and visit the various sources with a manual trolley, after the full fill the capacity of trolley, they conveyed the garbage to the nearest collection centre /transfer station, Or the waste is sent directly to the collection stations, ie each source converts its own waste to the nearest collection/ transfer station. Similarly, different types of vehicles are used for collection and transport, these vehicles leave the depot to visit a number of collection centers, transfer stations and processing plants and ends at the depot, and then the waste is treated at the processing plants, in order to transport the waste extracted after the treatment to the charging stations.

An integrated waste management system can improve the vehicle routing, dispatching, maintenance and management, the study of this system from the point of view of operational research involves modeling it through a logistics chain in which the following processes take place: the separation of the types of waste (cardboard, household, glass, plastic, ...) carried out at the source, collect the waste from the transfer stations and transfer the different types of waste to the different factories for treatment, each plant is of specific specialty, then to landfills. and in this paper, in order to optimize the total cost of transport, a scheme is developed for the collection and transport of solid waste: an optimization scheme is needed to reduce the total cost of waste collection and transport.

Problem descriptions

Optimizing the collection and transportation of municipal solid waste (MSW) by separating waste types at the source becomes a major concern in the design of the waste management system, due to the fact that the existing MSW management systems suffer by the high collection and transportation cost. In general, different waste transfer stations are dispersed in the city in a heterogeneous way, which increases the cost of collecting

and transporting waste. Therefore, a shortest waste collection and transportation strategy can effectively reduce the costs of collecting and transporting. To model this problem, we propose a schema that divides the entire integrated waste management system into three different parts: (i) transfer separated solid waste from different sources (households, markets, offices, etc.) to the compartmentalized transfer station, each compartment accommodating one or more supplies of the same type of product; (ii) transport the solid waste separated from the transfer station to the treatment plants via a compartmentalized fleet, each plant is of a specific specialty. However, during transport, the different types of waste must not be mixed, this is enabled by a specific device, which allows for separating the capacity of each vehicle individually into a limited number of compartments where each compartment can accommodate one or several supplies of the same product type. a transfer station can be visited several times to select different types of waste. However, if being picked up, each type has to be loaded in total. In other words, a split collection of a single type in a station is not allowed; (iii) transfer the produced waste from processing plants to the nearest landfill site. Each part contains huge amount of cost for waste collection or waste material transportation. The proposed scheme optimizes transportation cost of each part of the system. Therefore, the total waste management cost for the whole system is optimized.

References

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