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In this work we study a commodity constrained split delivery vehicle routing problem (C-SDVRP) where customers require multiple commodities. In the C-SDVRP, the vehicles are flexible and can deliver any set of commodities, and a customer who requires multiple commodities can be delivered by different vehicles. However, when a commodity is delivered to a customer, the entire required amount is handed over. This problem arises when customers require several commodities and they accept that commodities are delivered separately, but for convenience they require that each commodity is delivered only once. For example, in delivery of fresh fruits and vegetables to catering, commodities can easily be mixed into the same vehicle, and splitting the delivery of an individual commodity is not acceptable.

The C-SDVRP is to find a solution that minimizes the total transportation cost and that involves two related decisions such as finding a set of vehicle routes that serve all customers and to select the commodities that are delivered by a vehicle route to each customer. Moreover, each solution must be such that : (1) each route starts and ends at the depot ; (2) the total quantity of commodities delivered by each vehicle does not exceed the vehicle capacity ; (3) each commodity requested by each customer must be delivered by a single vehicle ; (4) the demands of all customers need to be satisfied.

This work aims at proposing an efficient heuristic to tackle medium and large sized C-SDVRP instances. To this end, we propose an adaptive large neighborhood search (ALNS) heuristic taking into account the specific features of the C-SDVRP. A C-SDVRP instance can be transformed into a CVRP instance by replicating each customer as many time as the required commodities, but this produce many equivalent solutions when exchanging commodities of the same customer. In order to avoid that, the proposed method explicitly takes into account the customer location associated to a commodity.

The proposed method relies on the ALNS algorithm and we apply some removals and insertions heuristics to the C-SDVRP. To improve a solution, we adapt existing local search (LS) operators in order to deal with a customer as a whole (i.e., with the whole demand he/she requires) or only as a part (i.e., with a single commodity he/she requires). Moreover, in order to further improve the quality of a new global best solution, mathematical programming based operator that reassigns commodities to routes is developed.

Computational experiments have been performed on benchmark instances from the literature. The results confirm the efficiency of the algorithm. We provide a large number of new best known solutions for medium and large sized instance with up to 100 customers and 3 commodities, within a short computing time.