Optimization of light oil products transportation to petrol stations of urban agglomerations

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Abstract. Transport is one of the most important sphere of material production that provides population with manufacturing and non-manufacturing needs in all types of transportation. In the modern conditions of globalization, the necessity of transport providing is rising. Now one of the successful transport action main conditions is the transport service quality level increasing (quality of delivery of transported cargo etc.) and reduction of transport costs (cost of transportation, turnover ratio etc.), that is why the new organizational approaches in this field are necessary for these aims achieving. The accounting parameters, that have influence on vehicles work on line, let the transportation efficiency increase, reduce business costs due to vehicles and stops on the line list quantity reduction.

Introduction
The light oil products delivery to petrol station is an important element of providing the undisturbed operation of both private passenger transport and industrial one [1].

The objective of this work is the light oil products transporting costs reduction by vehicles via reduction of their list quantity due to the transport process optimization.

The task of this work includes the following: research the oil products delivery process from petroleum-storage depot to petrol station by vehicle in details.

The process of oil products transportation from petroleum-storage depot to petrol station is considered. The general flow diagram is in figure 1.

It is shown in the figure that the transportation requirements presence depends on the fact if the required volume of work has been performed. Industrial practical data show, that in summer period this condition is met almost never. It is often connected with that region petrol station selling is more than a petroleum-storage depot capacity. Thus, the transport company, giving ultrahigh request for carriage, send all available transport to the petroleum-storage depot. The petroleum-storage depot because of its technical possibilities can’t unload this transport quantity on time, and, therefore, hourly queues, traffic congestion take place, the transport turnover ratio falls.

It is efficiently to apply the methods of queueing theory for optimal operation of transport in the conditions of limited capacity of petroleum-storage depot [2].

In accordance with queueing theory, loading system at a petroleum-storage depot can be described as follows: a closed system with waiting; relative priority; a few sources of service requests; one-time service.
In [3] the road productivity train with different semitrailers was calculated. For this calculation the semitrailer KAPRI 96398 was chosen. First, there is prevailing quantity of the road trains with these semitrailers (more than 75%) at the considered enterprise; secondly, the road train with the fully loaded semitrailer Capri 96398 has maximum mass, which is less than maximum acceptable values, and this fact allows to exploit the semitrailer freely.

Calculations won’t be shown in the work text, because of their big volume. Further some input(source) data are given: the petroleum-storage depot productivity -160m³/h; volume of the road train semitrailer - 32m³; the price of work of the petroleum-storage depot shift and a one road train - 800000 and 45000 rub. accordingly; a shift duration - 23hours; the time of moving with cargo and without cargo back - 1 hour.

**Figure 1.** General flowchart of the process of transportation of oil products

Based on the calculations results, we can take a number of dependencies, determining promising future direction for modernization of the light oil products transportation process, increasing of the productivity of the enterprise vehicles and also achieving economic profit due to reduction of costs.

Thus, for example, in the figure 2 dependence of the road train productivity and required quantity of the road trains from travel time is shown.
According to the results, it follows that the difference between the road train productivity with optimal level of petroleum-storage depot load (0.77) and the road train productivity with specified level of petroleum-storage depot load (0.85) is less than 1% while increasing of travel time (travel distance) is to 11.5 hours (based on manufacturing data about the travel time and the travel distance it is known that the travel time per day is 9-12 hours in 50-65% of travels).

Also, the difference between required quantity of road trains in the same conditions is 12 units, that is 8.7%. Therefore, the required vehicles quantity can be reduced by 12 units, without reduction of their productivity and exceeding of optimal petroleum-storage depot load.

**Figure 2.** Dependence of the road train productivity and required quantity of the road trains from travel time

It is known that one road train price is 13 million rubles, hence economic profit will be 156 million rubles by keeping of optimal petroleum-storage depot load and reducing of list quantity of vehicles. Besides, economic profit will be 197.1 million rubles per year because of reduction of maintenance costs for 12 road trains.

In the figure 3 dependence of road trains productivity and their required quantity from petroleum-storage depot productivity is shown.
Figure 3. The road trains productivity dependence and the required quantity from petroleum-storage depot productivity

Summary
The data received make it possible to conclude, that while increasing petroleum-storage depot productivity, road trains productivity falls and their required quantity rises while increasing petroleum-storage depot productivity if optimal petroleum-storage depot load exceeds. Thus, for boundary values of the considered series of values the difference in productivity is less than 1%, but the difference in required vehicle quantity is 7 units, that is 11.5%. Therefore, we can not only increase vehicles productivity, but also reduce their quantity by keeping an optimal petroleum-storage depot load by vehicles. Economic benefit will be 91 million rubles per year due to the vehicle fleet reduction, but because of the vehicles maintenance costs reduction it will be 115 million rubles per year.

The performed work let us conclude that technological process of loading is not perfect. The calculation shows that it is necessary to keep optimal petroleum-storage depot load by road trains for increasing vehicles productivity as well as costs reduction.

In further developing, the data obtained will allow to develop the hourly road train release calculation method to the line to keep the necessary load for load station. This method can be applied for any transport company and any loading conditions.

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