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Consumer and transport containers for road transportation of main types of petroleum cargoes, ergonomic requirements for handling and warehousing

The research conducted in the paper is devoted to solving the actual problem of development of methods for choosing the optimal assortment of consumer and transport containers for automobile transportation of the main types of petroleum products.

In the paper is proposed to expand the range of consumer and transport containers for automobile transportation of the main types of petroleum products due to the selection of such effective types as a tank container, a container of medium capacity for bulk cargo (IBC- container), flexitank, soft container type "big-bag".

Ergonomic requirements for handling the main types of oil products during their container transportation have some features that are also defined in the work.

petroleum cargoes, consumer container, transport container, road transportation, optimization, handling, warehousing, ergonomic requirements

Formulation of the problem. About two-thirds of the total consumption of the scarcest and most valuable light petroleum products obtained from oil refineries is accounted for by road transport, and gasoline carbureted and diesel internal combustion engines remain the most common power plants of cars [1]. Road transport is widely used in the transportation of petroleum products from distribution depots directly to the consumer. It is most effective in areas where it is impossible to deliver petroleum products by rail or waterways [2, 3]. The main purpose of motor vehicles is the delivery of finished oil products from large oil depots to smaller ones and further to the consumer. Petroleum products are delivered by tankers and fuel stations. Road transport accounts for about 20% of oil cargo transportation [3].

It should be noted that not enough attention is paid to container truck transportation of oil products.

Analysis of recent research and publications. The transportation of petroleum products and liquefied hydrocarbon gases by road transport is widely used when transporting petroleum products from distribution depots directly to consumers [2–6], and its most effective use is where it is impossible to deliver petroleum products by rail or water, as well as for delivery to consumers located a short distance from filling stations and warehouses and bases – for example, from oil depots to car farms, to gas stations, to rural fuel depots [7–10].

Setting objectives. The purpose of the paper is to development of a methodology for selecting the optimal assortment of consumer and transport containers for the main types of petroleum products, as well as types of vehicles for their transportation in bulk transportation.

Presenting main material. We will give the definition according to the standard: consumer packaging is packaging intended for packaging and delivery of products to the consumer, transport packaging is packaging intended for storage and transportation of products in order to protect them from damage during transportation and forms an independent transport unit; a vehicle is a device intended for road transportation of people, goods or equipment installed on it.

Petroleum products packed in transport containers are transported in containers or transport packages in covered vehicles in accordance with the Rules for the carriage of goods by road transport. When transporting by road, petroleum products in limited quantities are packed in accordance with the requirements [4].

Transport containers, vehicles with oil and petroleum products, in addition to transport markings, shall, if necessary, be marked with markings characterizing the transport hazard of the cargo. The warning inscription "Flame hazard" is placed on gas stations and tankers with petroleum products and oil gas stations.

Oil is a liquid natural fossil mixture of hydrocarbons of a wide physico-chemical composition, prepared for transportation by main pipeline, railway, road and water transport and/or for use as raw material in oil refining and petrochemical industries [8]. Oil and gas are the main raw materials during the production of automotive operating materials.

Oil is transported in tank containers by road transport (here and below for petroleum products). Transport container: metal barrel. When transporting in bulk: tank truck.

A tank container is a unit of reusable transport equipment consisting of a boiler and equipment elements, has standard dimensions and appropriate strength, and is structurally designed for the transportation of gaseous, liquid, solid (powdery or granular) substances by various types of transport without intermediate cargo overloading.

The main components of liquefied hydrocarbon gases (LHG), modern fuel for engines, are propane, butane and their mixtures [8]. These hydrocarbons are obtained from gases, accompanying oil, when drilling wells and gaseous fractions formed during various types of processing of petroleum products and hard coal.

Liquefied gases are stored in cylinders with a capacity of 250 liters (162...225 liters of gas provide a vehicle range of up to 500 km), designed for a working pressure of 1.6 MPa. In such conditions, even pure propane is in liquid form, which allows you to operate cars on liquefied petroleum gases all year round.

Propane and butane are valuable raw materials for the chemical industry, which limits the prospects for their widespread use in road transport.

LHG is transported in tank containers. Transport container: metal cylinder. When transporting in bulk: tank truck.

The variety of brands of gasoline and diesel fuel produced is related to the need to ensure the operation of engines with different detonation properties [9]. Unleaded gasoline A-72 is used for cars with non-forced engines. The main fuel for modern trucks and buses with carburetor engines is gasoline A-76, A-80, A-92, AI-91. Gasoline AI-93, AI-95, AI-95 "Extra" is the main fuel for most passenger cars produced at present, leaded gasoline AI-98 is intended for passenger car engines with a higher compression ratio.

Naphthyl fuel is intended for use as a fuel for jet engines and rocket fuel, it is a flammable liquid with a flash point in a closed crucible above 61 °C, a self-ignition temperature not lower than 220 °C, and an ignition temperature in the range from 28 °C to 60 °C.

Aviation gasoline, automobile gasoline, fuel for jet engines, naphthyl, diesel fuel are transported in tank containers [10]. Consumer packaging: metal flask, glass bottle. Transport container: metal barrel, metal canister. When transporting in bulk: tank truck, fuel tank.

Household stove fuel is intended for burning in low-power heating units located directly in residential premises, as well as medium-power heat generators used in agriculture for the preparation of fodder, drying of grain, fruit, canning and other purposes.

Transported in tank containers. Consumer packaging: metal flask. Transport containers: metal, polymer barrel, metal, polymer canister, medium capacity container for bulk cargo (IBC-container). When transporting in bulk: tank truck.

The medium capacity container for bulk cargo (IBC-container) is a cargo plastic container of medium capacity (with a capacity of 640 to 1250 L), intended for multiple use, and used for the transportation and storage of liquid, solid and loose products.

Marine fuels, fuel oils are transported in tank containers. Consumer packaging: metal flask, polymer flask. Transport containers: metal barrel, metal drum, metal canister, polymer canister. When transporting in bulk: tank truck.

Gas oil is transported in tank containers. When transporting in bulk: tanker truck, truck bitumen truck, truck-mounted cement mixer.

Kerosene is transported in tank containers. Consumer packaging: metal, polymer flask, metal, polymer, glass can, glass, polymer bottle, metal, polymer canister. Transport container: metal cylinder, metal barrel, polymer, metal canister, polymer. When transporting in bulk: tank truck.

Additives are transported in tank containers. Consumer packaging: metal, polymer flask, metal, polymer can, polymer bottle. Transport containers: metal barrel, polymer barrel, polymer canister, medium capacity container for bulk cargo (IBC container). When transporting in bulk: tank truck.

All oils of petroleum origin are divided into four groups: motor (for aircraft, gas turbine, carburetor and diesel engines), transmission, special (turbine, compressor, etc.) and for various purposes.

Oils are transported in tank containers. Consumer packaging: metal flask, polymer flask, metal, polymer, glass can, glass, polymer bottle, metal, polymer canister. Transport containers: metal, polymer barrel, metal, polymer drum, metal, polymer canister, medium capacity container for bulk cargo (IBC-container), flexitank. When transporting in bulk: a tanker truck, an oil filling station.

Flexitank is a flexible container (with a capacity of 10,000 to 24,000 liters) made of special polymer materials, designed for 20-foot universal containers, used for the transportation and storage of liquid products.

Plastic lubricants occupy an intermediate position between solid lubricants and oils. In the simplest case, they can be considered as two-component systems consisting of oil (dispersion medium) and thickener (dispersion phase).

Various lubricating fluids are used as a dispersion medium, which accounts for 75...95% of the volume of the lubricant. More than 95% of lubricants (from the total production) are made on the basis of petroleum oils. The dispersed phase (5...25%) forms a three-dimensional structural framework in lubricants, the cells of which hold oil. Therefore, at low loads, lubricants behave like solid bodies, and at critical loads exceeding the strength of the structural frame (usually 50...200 Pa), they flow like oils.

Plastic lubricants are transported in tank containers. Consumer packaging: metal flask, polymer flask, metal, polymer, glass, tube. Transport containers: metal, polymer, wooden barrel, metal, polymer, plywood, cardboard drum.

Lubricants (sulfox, protective wax, copper naphthenate for anti-rot mixtures, ZKN) are transported in tank containers. Transport container: metal, polymer, wooden barrel, metal, polymer drum.

Vaselines are used in medicine, veterinary medicine and electrical engineering.

Vaselines are transported in tank containers. Consumer packaging: metal, polymer flask, metal, polymer, glass can, polymer canister. Transport container: metal barrel, metal drum, polymer.

Clovertainer-type bitumen cubic container is a container made of multi-layer cardboard or plywood on a wooden pallet, designed for the packaging, transportation and storage of petroleum products, including petroleum bitumen, polymer-bitumen binders,

modified bitumen, bitumen compounds, raw materials for the production of bitumen, and similar petroleum products with a softening temperature not lower than 35°C.

Raw materials for the production of bitumen, tar, petroleum asphalt are transported in tank containers.

Transport container: metal barrel, polymer, metal drum, polymer, cubic container for bitumen of the clovertainer type, container of medium capacity for bulk cargo (IBC-container), flexitank, soft container of the "big-bag" type, paper bag, polymer bag, etc. . When transporting in bulk: tanker truck, bitumen truck, tar truck.

A soft container of the "big-bag" type is a body made of soft material, or a combination of them, and has, if necessary, an inner coating and the appropriate operational equipment and load-catching devices.

Naftobitumen is a mixture of high-molecular, liquid or solid hydrocarbons and tar-asphalt substances. Bitumen has been one of the most famous and important building materials since ancient times. Due to its adhesive and hydrophobic properties, it is widely used in road construction, manufacturing of roofing materials, in the construction of foundations of buildings and structures, laying of pipelines.

Liquid road bitumens are transported in tank containers. Transport containers: metal barrel, polymer drum, metal drum, polymer drum, plywood, cardboard winder, cubic container for bitumen of the clovertainer type, medium capacity container for bulk cargo (IBC-container), flexitank, soft container of the "big-bag" type. When transporting in bulk: tank truck, bitumen truck, tar truck.

Viscous road bitumen, roofing bitumen, construction bitumen are transported in tank containers. Consumer packaging: cardboard box with an insert made of non-stick paper. Transport container: metal barrel, polymer, wooden drum, metal drum, polymer, plywood, corrugated cardboard, cubic container for bitumen type clovertainer, container of medium capacity for bulk cargo (IBC-container), flexitank, soft container of the "big-bag" type, a paper bag, a polymer bag, etc. When transporting in bulk: a bitumen truck, a tar truck.

Paraffin is a mixture of solid high-molecular boundary hydrocarbons of normal structure.

Ceresin is a mixture of solid high-molecular boundary hydrocarbons mainly of isostructure. Designed for obtaining lubricants, wax alloys, insulating materials and products of electronic industry enterprises.

Liquid petroleum paraffins. Transport container: metal barrel, polymer barrel, wooden barrel, polymer drum. When transporting in bulk: tank truck.

Solid petroleum paraffins. Consumer packaging: metal flask, metal can, polymer. Transport container: metal, polymer, wooden barrel, metal, polymer, cardboard drum, cubic container for bitumen of the clovertainer type, container of medium capacity for bulk cargo (IBC-container), flexitank, soft container of the "big-bag" type ", box, paper bag, polymer bag, etc.

Petrolatum is a product of deparaffinization of residual petroleum oils of selective purification, which is a mixture of solid paraffin, ceresin and from 7% to 38% of petroleum oils, used as a raw material for obtaining ceresin, a component of lubricants, electrical insulating compounds, an antiozonant for rubber, below the flash point of 240 °C, drop temperature from 55 °C to 65 °C, sulfur content slightly more than 0.6%. Petrolatum is used to obtain ceresin, hydrocarbon lubricants, petroleum jelly, for drying wood and other purposes.

Gach is a product of deparaffinization of petroleum distillate oils, used for the production of solid paraffins and other oil refining and petrochemical processes, with a flash point in a closed crucible not lower than 180 °C, a melting point not lower than 49 °C, a

sulfur content of not more than 0.5% . In other words, wax is a crude paraffin wax with a high oil content.

Unrefined petrolatum, gac and ceresine are transported in tank containers. Consumer packaging: metal, polymer flask, metal, polymer can. Transport container: metal, polymer, wooden barrel, metal, polymer, plywood, cardboard drum, soft "big-bag" type container. When transporting in bulk: tank truck.

We will present the main ergonomic requirements from the point of view of carrying out loading and unloading and transport and storage operations with the main types of petroleum products.

By mass, cargoes transported by road transport are divided into three categories.

The first category by weight of tared and piece cargoes includes those that have a mass of one place less than 30 kg, the second category - those that have a mass of one place from 50 to 500 kg; to the third category - more than 500 kg.

Cargoes transported by road transport is divided into four groups according to the degree of danger during loading, unloading and transportation.

The first group of cargoes according to the degree of danger during loading, unloading and transportation (low-hazard cargoes) include construction materials, food products, etc., the second group – dangerous due to their size (oversized), the third group – dusty or hot include cement, mineral fertilizers, asphalt, bitumen, etc., dangerous cargoes belong to the fourth group.

The movement of goods of the 1st category from the warehouse to the place of loading or from the place of unloading to the warehouse can be organized manually, if the horizontal distance does not exceed 25 m. If the distance is greater, such goods must be transported by mechanisms and devices. In exceptional cases, loading and unloading of goods weighing up to 55 kg (one place) may be carried out manually by two loaders at places of non-permanent loading and unloading. Transportation, loading and unloading of cargo of the 2nd and 3rd categories at all permanent and temporary loading and unloading platforms (points) must be mechanized.

Tared and piece cargoes that rise above the sides of the body must be tied with strong, serviceable rigging (ropes, ropes). It is forbidden to use metal ropes and wire.

Tared and piece cargoes in boxes, barrels, cans, bottles, etc. must be stacked in such a way that they cannot move on the floor of the body when moving from a place and making sharp turns, sharp braking. Between individual cargo spaces, when there are gaps between them, strong spacers and spacers made of wood are inserted.

Liquid cargoes in barrels should be put up with a cork.

The same applies to glass tares with liquids, which are accepted for transportation only in special packaging.

Cargoes in glass tares, in order to ensure their integrity, cannot be installed in two layers without the presence of spacers (boards) of a certain quality.

Drivers and workers who are engaged in the transportation, loading and unloading of dusty goods or poisonous substances must be provided with appropriate means of personal protection.

Labels that indicate the type of dangerous cargoes, the presence of fragile vessels in the package, as well as the top of the package, must be on all cargo units of dangerous substances.

Loading and unloading operations with dangerous cargoes cannot be performed with a defective tare, in the absence of markings and warning inscriptions on it, when the tare does not meet the requirements of regulatory and technical documentation.

Dangerous cargo to and from the vehicle must be loaded with its engine turned off, with the exception of the cases of pouring and draining petroleum products into the tank truck, which is done with the help of a pump installed on the vehicle and driven by the vehicle's engine. In this case, the driver is near the pump control panel.

It is prohibited:

- to transport dangerous cargoes and food products or fodder together;
- to burn and use an open fire when loading, unloading and transporting explosive, fire-hazardous cargoes.

Conclusions.

1. Road transport mainly ensures the delivery of petroleum products to remote agricultural areas, as well as for the internal movement of petroleum products from oil depots to places of consumption. Transportation of petroleum products from the oil depot to the consumer is carried out by tankers, on-board cars, and trailers.

2. In connection with the need to deliver petroleum products to consumers in a full range, it is suggested to organize combined transport, that is, when sending, for example, containerized petroleum products by flatbed truck, light petroleum products can be transported in special mobile tanks of relatively small capacity, taken on a trailer to a flatbed truck. When transporting petroleum products in tanker trucks, containerized petroleum products can be transported in flatbed trailers.

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Споживацька і транспортна тара для автомобільних перевезень основних видів нафтопродуктів, ергономічні вимоги до поведження і складування

Проведені у даній статі дослідження присвячені вирішенню актуальної проблеми розробки методики вибору оптимального асортименту споживацької і транспортної тари для автомобільних перевезень основних видів нафтопродуктів. При цьому слід відмітити, що тарним автоперевезенням нафтопродуктів приділяється недостатньо уваги. Автомобільний транспорт в основному забезпечує завезення нафтопродуктів у глибинні сільськогосподарські райони, а також для внутрішнього переміщення нафтопродуктів від нафтобаз до місць споживання.

До основних видів нафтопродуктів, що перевозяться автомобільним транспортом, відносяться такі достатньо різні за своїми властивостями речовини, як бензини авіаційні, бензини автомобільні, палива для реактивних двигунів, нафтил, паливо дизельне, зріджені вуглеводневі гази, мастила нафтового походження, вазеліни, сировина для виробництва бітуму, гудрон, асфальт нафтовий, власне нафтобітум, парафіни нафтові рідкі та тверді. Визначено, що нафтопродукти, упаковані у транспортну тару, транспортують у контейнерах або транспортними пакетами у критих транспортних засобах відповідно до Правил перевезення вантажів автомобільним транспортом. При транспортуванні автомобільним транспортом нафтопродукти в обмежених кількостях упаковують відповідно до вимог Рекомендацій щодо перевезення небезпечних вантажів (типових правил, розроблених Організацією Об'єднаних Націй). На транспортну тару, транспортні засоби з нафтою та нафтопродуктами крім транспортного маркування, за потреби, завдають маркування, що характеризує транспортну безпеку вантажу.

В роботі запропоновано розширити асортимент споживацької і транспортної тари для автомобільних перевезень основних видів нафтопродуктів за рахунок вибору таких ефективних її видів, як контейнер-цистерна, контейнер середньої вантажопідйомності для масових вантажів (ІВС-контейнер), флексітанк, м'який контейнер типу "біг-бег". Якщо правила техніки безпеки і охорони праці, ергономічні вимоги при транспортуванні нафтопродуктів наливом визначені чітко і докладно, то ці ж вимоги до тарного транспортування мають деякі особливості, які визначені в роботі.

нафтопродукти, споживацька тара, транспортна тара, автомобільні перевезення, оптимізація, поведження, складування, ергономічні вимоги

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