ROAD NETWORK AND WASTE PROBLEM

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ABSTRACT

The authors of the article systematize the processes of waste generation of the motor transport complex throughout the life cycle of the constructed and operated road. At the same time, variants of land, underground and aboveground lines, solid and liquid waste types, as well as factors affecting their quantitative indicators, and the features of the most waste-generating activities related to the road industry are differentiated.

Keywords: road network, transport enterprises, construction, reconstruction, operation, waste.

Background. *The road network with the objects of the road transport complex occupies significant territories. At the same time, as a result of the use of transport communications and the operation of cars with internal combustion engines, environmental pollution is caused by road transport waste. The main sources of waste are road transport enterprises, road construction equipment bases, garages, parking lots, washing stations, gas stations, service stations, as well as the road and bridges. That is, it is a complex problem of development and maintenance of the road transport network, maintenance, repair and operation of cars, production of combustible and lubricating materials.*

The following types of wastes are typical for road transport activities:

1) liquid (solvents, petroleum products, suspensions, chlorides, antifoaming agents) – are formed during washing, cleaning of parts, electrochemical treatment of materials, use of special salt formulations to maintain the road network in an efficient condition, etc. They are the main pollutants of sewage.

In transport enterprises, on average, 100 kg of discharges into surface water bodies per year are accounted for by a unit of rolling stock, including a dry residue – 76, chlorides – 17, sulfates – 4, suspensions – 1, the rest – 2 kg [1], a large volume of mud, containing many harmful impurities, including petroleum products and heavy metals.

2) solid – are formed both in the operation of transport communications, and the use of vehicles (until the end of their life). These wastes:

– are transported for disposal to landfills and dumps;

– are transferred for processing or disposal to other enterprises;

– are used for own needs.

Let us dwell in more detail on waste generated during the whole life cycle of the road – during its construction, expansion, reconstruction, operation.

Objective. *The objective of the authors is to consider waste problem in the road network.*

Methods. *The authors use general scientific methods, comparative analysis, evaluation approach.*

Results.

Road construction

In a city where all the areas are already occupied by either buildings (wooden or brick), or green plantations, or already laid roads, the construction of a new route can be conducted in three versions:

a) ground – with demolition of disturbing buildings and cutting down trees,,

b) underground – tunnel,

c) aboveground – overpass or bridge across the water barrier.

During construction are formed:

1) waste of land and soil,
2) waste of rubble,
3) waste of sand,
4) waste of asphalt-concrete mixture,
5) waste of bitumen,
6) waste of iron,
7) waste of concrete,
8) waste of reinforced concrete structures,
9) waste of metal structures,
10) cut down green plantations,
11) destroyed and demolished buildings.

In the laying of the road, many types of industry are involved, which increase the volume of waste from production activities. They involve the mining industry – quarries for supply of road building materials (gravel, crushed stone, rubble stone, sand), and processing industry (stone crushing plants, bases for preparation of sand and gravel mixtures, organic and bituminous astringent emulsions, plants for processing tar in bitumen, factories of reinforced concrete structures, asphalt concrete). The main factor affecting here the mass of waste is the mass of the product.

Reconstruction and expansion

The concept of «reconstruction» includes repairs (a complex of operations for restoration of serviceability) and expansion of the road. In this case, the main type of work is repair of the road surface with preliminary removal of the worn layer by milling and forming a new layer. In the course of such operations are formed:

1) waste in the form of the removed top layer of asphalt,
2) waste of rubble,
3) waste of sand,
4) waste of the asphalt-concrete mixture.

With expansion of the road, the same types of wastes appear as in construction, but in a reduced amount, depending on the scale of the work done, and waste in the form of the removed top layer of asphalt from the repaired area.

Operating waste

When operating and maintaining a road, the following are formed:

1) Waste from vehicles.

1) Volumes of solid waste in technological processes of the life cycle of transport facilities are determined by the frequency of routine maintenance, the level of reliability of the structure, the nomenclature of the equipment used, and the degree of accident of vehicles.

2) Waste from road transport enterprises located directly at the road and serving the passing transport.

During the maintenance and repair of equipment are used: rolled metals (round and hexagonal bars, sheet steel, lead, tin, copper, metal products, etc.), tools, electrical and friction materials [2].

The consumption of structural materials that fall on spare parts, which are necessary to restore the efficiency of units and parts of vehicles, is significant. As a result of machining of parts, their replacement, as well as other types of production activities in transport enterprises are formed per car per year [3]:

– about 250 kg of solid waste, exported to landfills and landfills, including: sweepings – 40 %, consumption wastes – 19 %, wood waste and waste paper – 16 % each, brake linings – 4 %, cullet – 3 %, rubber (except tires) – 2 %;

– about 900 kg of waste transferred by transport enterprises for further processing to other enterprises, including: scrap of ferrous metals – 38 %, sewage treatment sludge – 31 %, tires – 20 %, waste oil – 9 %, scrap of storage batteries – 2 %.

Part of the generated solid waste finds its application directly in the enterprises: wood chips – as an adsorbent in the case of oil spills, sulfuric acid – is drained from faulty storage batteries, is regenerated and reused.

3) Waste of the fuel station.

4) Waste from trade and food institutions.

5) Solid household waste from road users (garbage containers along the road).

6) Sweepings from the territory of the road, one of the components of which are products of wear of rubbing parts, wear of tires and brakes, and destruction of the roadway.

Conclusion. *Thus, depending on the type of work (reconstruction or construction) and the selected route option, a different amount of waste is generated [4]. Among them, the largest volume is occupied by waste from asphalt, obtained during repair of the roadway, dumps of excavated soil during excavations during construction of new sites and construction debris remaining during demolition of buildings. The most waste-generating type of work is reconstruction of the road by removing the top pavement.*

REFERENCES

1. Evgeniev, I. E., Karimov, B. B. Roads in the environment [*Avtomobil'nye dorogi v okruzhajushhej srede*]. Moscow, Transdornauka publ., 1997, 285 p.

2. Babkov, V. F. Automobile roads [*Avtomobil'nye dorogi*]. 3rd ed., rev. and enl. Moscow, Transport publ., 1983, 280 p.

3. Lukanin, V. N., Trofimenko, Yu. V. Industrial and Transport Ecology: A Textbook [*Promyshlenno-transportnaja ekologija: Uchebnik*]. Moscow, Vysshaja shkola publ., 2001, 273 p.

4. Naiman, S. M. Formation of industrial waste in the life cycle of the road [*Obrazovanie proizvodstvennyh othodov v zhiznennom cikle dorogi*]. *Ekologija i promyshlennost' Rossii*, 2004, Iss. 8, pp. 35–39.

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