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Analysis of the garbage truck market of Ukraine

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In this work, with the help of object-oriented statistical analysis of the offers of specialized equipment of domestic manufacturers, the compliance of the specialized transport and technological support offered by the market with the needs of the long-term planning of waste management systems at the local and regional levels are established. The range of their products cannot always ensure maximum logistical efficiency when implementing separate collection technologies due to the low presence of offers of garbage trucks with multi-section bodies. When implementing a cluster strategy, which involves the organization of multi-stage transportation of solid waste, there is a danger of a shortage of specialized transport garbage trucks

Keywords: garbage truck, manufacturer, market, need, planning

Аналіз ринку сміттєвозів України

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Практичний досвід організації санітарної очистки населених пунктів свідчить, що ефективність систем поводження з твердими побутовими відходами (далі – ТПВ) значно залежить від транспортного забезпечення. Але у роботах українських науковців практично відсутній детальний аналіз пропозицій спеціалізованої техніки на ринку України, хоча асортимент технологічного обладнання є одним із факторів оптимального планування. В даній роботі за допомогою об'єктно орієнтованого статистичного аналізу пропозицій спеціалізованої техніки вітчизняних виробників встановлюється відповідність пропонованого ринком спеціалізованого транспортно-технологічного забезпечення потребам перспективного планування систем поводження з відходами місцевого та регіонального рівнів. На даний час в Україні існує 8 основних виробників спеціалізованої комунальної техніки для збору і транспортування ТПВ: Публічне акціонерне товариство «АвтоКрАЗ», Турбівський машинобудівний завод, ПрАТ «Спецбудмаш», ТОВ БНТЕД «Комунтехніка», ТОВ Торгова компанія «ВЛІВ», ТОВ «Автоскладальне підприємство «КОБАЛЬТ», Завод комунальної техніки «АЛЬФАТЕКС», ВАТ «АВТЕК». Асортимент їх продукції на даному етапі розвитку систем поводження з відходами (період впровадження одноетапних схем перевезень) здатен повністю задовільнити всі потреби спеціалізованих підприємств у сфері поводження з відходами. Але не завжди може забезпечити максимальну логістичну ефективність при впровадженні технологій роздільного збирання через низьку присутність пропозицій сміттєвозів з багатосекційними кузовами. При реалізації кластерної стратегії, яка передбачає організацію багатоетапного транспортування ТПВ існує небезпека нестачі спеціалізованих транспортних сміттєвозів. Крім того, жоден з українських виробників не пропонує моделі типу «Farid Micro S» з можливістю перевантаження

Ключові слова: виробник, планування, потреба, ринок, сміттєвоз



Introduction

Issues related to the collection, utilization and disposal of production and consumption waste are relevant for almost all regions of Ukraine. The processes of collection, transportation and disposal are interrelated stages of sanitary cleaning of settlements. Together with the mechanisms of rational nature management and environmental protection, they make up a single system for ensuring the ecological safety of the functioning of the city economy. The practical experience of organizing sanitary cleaning of settlements shows that the efficiency of solid waste management systems depends significantly on transportation. However, today the majority of the existing fleet of garbage trucks has long been morally and physically outdated and needs updating.

Review of the research sources and publications

Updating a specialized transport fleet is a complex issue that has a number of technological [1], organizational and conceptual [2, 3], and architectural and planning [4] conditions. For example, the article [5] analyzed the work in the field of creating a methodology for determining the economic feasibility of transitioning to an updated structure of the fleet of specialized garbage collection vehicles. The paper [6] provides an analysis of the prospects for the use of various types of specialized garbage collection and transport equipment, including the prospects for the use of multi-section garbage trucks.

A number of studies are devoted to the management of transport flows in waste management systems at the regional level [7, 8]. The method of determining the rational carrying capacity of garbage trucks from the existing model range of cars [9] allows you to choose the brand of the car. The authors of the work [10] prove the need for a comprehensive assessment of the transport process, taking into account operating costs and capital investments. An important role in ensuring the efficiency of the logistics component of the waste management system is played by the operation of garbage trucks, in particular the reliability of the equipment [5]. But in the works of Ukrainian scientists, there is practically no detailed analysis of the offers of specialized equipment on the market of Ukraine, although the assortment of technological equipment is one of the factors of optimal planning.

Definition of unresolved aspects of the problem

Recently, regional waste management programs have been widely implemented in Ukraine, such as [11]. But one of the weak points of their implementation, which was identified by us during development [11], is transportation, especially for highway transportation of solid waste. In addition, Europe and the USA have long and widely used garbage trucks of various types, including those with multi-section hoppers. In Ukraine, such experience is still minimal. Therefore, increasing the efficiency of regional waste management systems through rational planning of the logistics component using modern technological means is an urgent task.

Problem statement

When planning waste management systems, the technological equipment available on the country's market can be used. There are offers on the Ukrainian market both from our own producers and from foreign ones. But the price range of foreign offers is, as a rule, significantly higher than domestic offers. Therefore, many communities, especially rural ones, pay more attention to domestic products. In addition, the guarantee of stable economic development of the state is the support of its own producer. Therefore, the task of our work is to analyze the compliance of domestic manufacturers' offers of specialized equipment with the needs of long-term planning of waste management systems at the local and regional levels.

Basic material and results.

A modern garbage truck is a complex piece of equipment, which is characterized by a complex of various parameters that determine its scope of application, the possibility and effectiveness of its use in various conditions. The technical characteristics of the garbage truck can be divided into three categories: general characteristics, characteristics of the basic chassis, characteristics of technological equipment. All these characteristics are of primary logistical importance.

The category of general characteristics includes:

- mass of transported waste;
- total weight of the vehicle;
- overall characteristics of the car;
- minimum loading height.

The basic chassis is characterized by the following indicators:

- engine type, volume and power;
- maximum speed of movement;
- wheel formula;
- fuel consumption for movement.

The characteristics of the technological equipment are largely determined by the type of garbage truck. However, a number of general technological features can be identified (table 1).

Table 1 – The main technological parameters affecting the choice of a garbage truck

Logistically significant	Additional technological and informative parameters
<ul style="list-style-type: none">– hopper volume;– type of containers;– compression ratio;– loading time;– pressing time;– unloading time;– location of the manipulator;– fuel costs for loading operations.	<ul style="list-style-type: none">– unloading system;– load hopper volume;– permissible load on lifting equipment;– working pressure in the hydraulic system;– method of controlling technological equipment..

Often there is a situation when manufacturers provide a very concise list of characteristics in their advertising information, which often does not reflect all the parameters necessary for planning logistics schemes. Another significant problem is the lack of a single standardized system of characteristics of specialized equipment, as a result of which each manufacturer presents the set of parameters it considers necessary. On the one hand, this situation somewhat complicates the process of choosing the most optimal technological support for waste management systems. On the other hand, it does not contribute to the dissemination of information about products at the stage of planning logistics schemes with a recommended choice of specialized equipment.

In this work, we are trying to analyze the products of leading Ukrainian manufacturers according to the main functional and technological types. Currently, there are 8 manufacturers, described below, on the Ukrainian market.

1) PJSC "AvtoKRAZ" (Kremenchuk) offers in its assortment [12]:

- garbage truck based on the KrAZ-6511N4 chassis with interchangeable containers for mechanized loading, transportation and unloading of solid household, large-sized construction and household waste, as well as transportation of interchangeable bodies of various functional purposes;

- portal garbage truck based on the KrAZ-5401N2 chassis with a gas engine;

- side-loading garbage truck based on the KrAZ-5401N2 chassis;

- the KrAZ-65053 garbage truck is equipped with a metal platform with an opening rear side, a manipulator crane with replaceable special grips and an MPR-1 or MPR-2 loading and unloading mechanism (multilift);

- Hidro-MAK garbage truck based on KrAZ-5401H2 with rear loading for all types of containers with a volume of 0.5-1.1m³;

- garbage truck KrAZ-65053 (VVC 120) is equipped with a hydromanipulator crane with a grapple, can be produced in two versions: with multi-elevator loading and unloading of the MPR-2 container and VVC 120 tipping hopper with rear unloading. This garbage truck is optimal for working with large-sized waste, but due to its overall parameters, it has limitations for use in the architectural and planning conditions of certain territories of urban-type villages.

2) Turbiv Machine-Building Plant offers in its range [13]:

a) Cars with side loading, where the body of the garbage truck is filled with solid household waste mechanically, from containers from 0.75m³ to 1.1m³. These are garbage trucks of the KO series with bunkers from 9 to 22 m³ on GAZ, MAZ, KAMAZ, MAN, DAF chassis.

b) Cars with rear loading of the KO series with bunkers from 9 to 13 m³ on GAZ, MAZ chassis.

There are no detailed product characteristics on the company's official website.

3) PJSC "Spetsbudmash" (Brovary) offers SBM

series cars on MAZ chassis [14] with rear manual loading, with rear mechanized loading, with side loading, portal garbage truck.

4) LLC BNTED "Komuntehnika" (Kyiv) offers garbage trucks of the KO series for all types of containers with a volume from 0.12 m³ to 1.1 m³ based on MAZ, GAZ, KAMAZ vehicles [15]. BNTED Komuntehnika LLC is an official dealer of Spetsbudmash PJSC and other leading manufacturers of special equipment. The main activity of the enterprise is the sale of special equipment of other manufacturers. Garbage trucks are represented almost entirely by Spetsbudmash PrJSC. In some cases, the company can install ready-made special equipment on the chassis to order. Therefore, the technical characteristics of cars are similar to the characteristics of SBM cars.

5) Trading company "VLIV" LLC (Kremenchuk). The enterprise has a complete technological production cycle. The assortment of garbage trucks consists of units of the KO series with a body volume of 7-23 m³ with side and rear loading for all types of containers (0.75 m³; European standard DIN 840-3 with a volume of 0.5-1.1 m³), as well as cars with skip-lift gantry and multi-lift hook systems for loading changeable bodies without pressing solid waste. Skiplift portal systems are designed for open containers with a volume of up to 8.0 m³, multilift hook systems work on the technology of replacing storage containers with a volume of up to 33 m³ on the base chassis and unloading Grumbach-type containers from them. The main models [16]:

a) With side loading from the volume of the bunker is from 9 to 21-22 m³.

b) With rear loading from the volume of the bunker is from 7 to 19-22 m³.

c) Portals: SKIPLIFT (hopper volume 10 m³), MULTILIFT (maximum load up to 26 tons).

6) Auto-assembly enterprise "COBALT" LLC (Kharkov) produces 4 modifications of garbage trucks with rear loading for all existing types of containers with a volume from 0.12 m³ to 1.1 m³ on a FOTON DAIMLER chassis with a body volume of 6- 14 m³, as well as cars with skip-lift portal systems for loading changeable bodies without pressing solid waste up to 8.0 m³. The main models [17]:

a) With rear loading: KGB-65, KGB-80, KGB-120, KGB-140 with a hopper volume of 6.5, 8, 12, and 14 m³, respectively.

b) Portals: KGP-8.1, KGP-8.2.

7) The main field of activity with "ALFATEKS" municipal machinery company (Kremenchuk) manufactures and sells utility, road and construction special equipment based on domestic and foreign chassis. The enterprise has a full technological cycle of production of communal equipment under the "JSC" trademark, which includes garbage trucks, vacuum machines, sludge suction machines, ditch washing machines, road combined machines. The main models of garbage trucks [18]:

a) With side loading (hopper volume 9, 12, 18.5 m³): series JSC on GAZ and MAZ chassis of various models, DAYUN CGC1120, SHACMAN.

b) With rear manual loading (hopper volume 9.2 m³.): series JSC on DAYUN CGC1120, MAZ-4371N2, GAZ-33098 chassis.

c) With rear mechanized loading (hopper volume from 9 to 22 m³.): series JSC on GAZ and MAZ chassis of various models, DAYUN CGC1120, SHACMAN, Renault D12, IVECO Eurocargo ML180E25, Renault C 6×4.

d) Portals (hopper volume 6-10 m³.): series JSC on chassis GAZ-33098, MAZ-4371N2, DAYUN CGC1140.

8) JSC "AVTEK" (Kyiv) - official distributor of FORD TRUCKS and official dealer of MAZ, MTZ, SOLARIS, RASCO, KASSBOHRER, HIDRO-MAK, ERDEMLI, HYVA. One of the largest manufacturers of special equipment in Ukraine, which offers a wide range of garbage trucks for various purposes [19]:

a) With side loading (hopper volume 11.5, 13, 22 m³.): MAZ-4907S0-030; MAZ-5909S3-310; FORD TRUCKS 1833D; MAZ-437121; MAZ-4907N2-030; Ford Trucks 2633 DC;

b) With rear mechanized loading (hopper volume from 5 to 24 m³.) with HIDRO-MAK equipment on IVECO, FORD TRUCKS, MAZ, FORD TRUCKS 1833 DC with container washer, Volvo FM330, Mercedes-Benz Arocs 2533.

c) portal (hopper volume 17 m³): MAZ-4906N2;

d) bunker trucks (hopper volume 34 m³.) on MAZ-6950S5 chassis;

e) HIDRO-MAK semi-trailer with autonomous engine (hopper volume 40 m³).

A special category of rear-loading machines is multi-section garbage trucks. This type of garbage truck is widely distributed in Europe and America, but in Ukraine it is still not widely represented. But with the planned implementation of the strategy of transition from unitary collection to separate in the conditions of village-rural type of logistics, multi-section garbage trucks have great prospects for implementation as a type of special equipment that can significantly improve the technical and economic efficiency of the logistics component of regional (and especially local) waste management systems.

Advantages of this system:

- use of all types of containers;
- the possibility of transporting different types of waste in one car;
- low level of operational and logistics costs.

In order to organize the separate collection of garbage, it is necessary not only to provide the sites with special containers for the separation of potential raw materials for further processing, but also to organize the separate removal of different fractions. This requires separate units of equipment for each fraction, or, more efficiently, garbage trucks specially designed for separate reception of waste.

Examples of such machines can be garbage trucks of the Turkish company HIDRO-MAK (ECOTWIN series), German Faun (SELECTAPRESS series) and Norba (MF300 series), Finnish NTM (series K-2K, KG-2K, FK, OM-2K, TRIO, QUATRO), Italian

FARID (Selecto series).

It should be noted that the HIDRO-MAK company is the only company that supplies multi-section garbage trucks to the Ukrainian market through its representatives in Ukraine (Suchasni Vantazhivky LLC (better known on the Ukrainian market under the trademark AVTEK) and HYDROMARKET LLC) for separate collection of solid waste. But the rate of sale of such cars in Ukraine is extremely low, which is due to the lack of widespread implementation of the technology of separate collection of solid waste in most townships and rural communities. So, for almost 10 years of work of official representatives of the company in Ukraine, a little more than 100 cars were sold.

A generalized description of the types of garbage trucks present on the market of Ukraine and their compliance with the logistics structure provided for by the RVMP [11] is given in Table 2.

Thus, the range of products of Ukrainian manufacturers of garbage trucks at this stage of the development of waste management systems (the period of implementation of one-stage transportation schemes) is able to fully satisfy all the needs of specialized enterprises in the field of waste management. But it cannot always ensure maximum logistical efficiency when implementing separate collection technologies.

Table 2 - Correspondence of the types of garbage trucks of Ukrainian manufacturers to the logistics structure provided for by the RVMP [11]

Body type	Body volume, m ³	Compliance with the requirements of RPUV
With side loading	8-18	responds
With rear loading	6-24	responds
Portals	8-17	responds
Bunker trucks	30-35	responds
Transportation	40-60	needs to expand the assortment
Multi-section	2 sections from 4+8m ³ to 8+16m ³	needs to expand the assortment

Some types of products are presented only by individual manufacturers. Yes, only PJSC "AvtoKRAZ" offers large-volume container trucks with a grab system. Large-volume container trucks with a container volume of more than 30m³ with the "multilift" system are offered by PJSC "AvtoKRAZ", OJSC "AVTEK", LLC Trading company "VLIV".

OJSC "AVTEK" is the only company that offers transport semi-trailers manufactured by the company "HIDRO-MAK" with a volume of 40-60m³. Also, OJSC "AVTEK" is the only company that offers multi-section garbage trucks with technological equipment of the company "HIDRO-MAK" and only one model of garbage truck with the function of washing containers.

It should be noted that the assortment of such manufacturers as PJSC is limited "AvtoKrAZ" and "KOBALT" Auto-assembly enterprise LLC. But, at the same time, in the range of PJSC "AvtoKrAZ" has types of equipment for working with bulky waste.

A characteristic technological feature of almost all models is the typical maximum solid waste compression ratio: up to 5 for side-loading systems and up to 6 for rear-loading systems. European manufacturers, such as the German company FAUN, produce the POWERPRESS and ROTOPRESS series of rear-loading garbage trucks. The FAUN POWERPRESS equipment has a compression ratio of up to 7. The drum rotation principle used in the FAUN ROTOPRESS is the most economical for solid waste. The compression ratio reaches 9. It is certain that the use of such equipment significantly increases the efficiency of the waste management system, and the development of these technologies by Ukrainian manufacturers is one of the promising directions.

With the implementation of a cluster strategy, which involves the organization of multi-stage transportation of solid waste, there is a danger of a shortage of specialized transport garbage trucks. The main part of the offers of transport garbage trucks on the market of Ukraine consists of used equipment that has almost exhausted its resource. As an extreme option, hopper garbage trucks with a hopper volume of 34m³ with preliminary pressing or conventional trucks with semi-trailers of large volumes can be used.

With the widespread implementation of the technology of separate collection of solid waste, the regional waste management system may have low technical and economic efficiency due to the too low level of representation of multi-section garbage trucks on the market of Ukraine.

In addition, none of the Ukrainian manufacturers offers models of the "Farid Micro S" type with the possibility of overloading, which is especially relevant in perspective scenarios of the development of regional waste management systems with the organization of multi-stage transportation schemes.

The main part of the products of the Ukrainian manufacturers of garbage trucks was based on the chassis produced in Belarus and Russia. Modern realities require the reorientation of domestic manufacturers of special equipment on the chassis of other global suppliers, since there is no actual production of the necessary equipment in Ukraine.

Wide coverage of rural settlements with sanitary cleaning schemes is already beginning. At the same time, there is often a situation of an unsatisfactory condition of the road network, which determines the need for the modernization of roads or the use of appropriate equipment. But there are no offers of garbage trucks with four-wheel drive chassis on the Ukrainian market.

Conclusions

The development of regional waste management systems dictates its requirements for the reorganization of the structure of the modern market of garbage trucks in Ukraine. The existing structure makes it possible to provide in full only the needs of the first stage of the implementation of the Regional Plan [11], provided that the fleet of basic chassis is promptly replaced by the majority of manufacturers. The implementation of the scenarios of promising periods requires a more significant modernization of the fleet of specialized equipment: the introduction of more effective solid waste pressing technologies, the expansion of the assortment of machines with the function of washing containers, the introduction of the production of garbage trucks with the function of overloading, the development of the production of specialized transport garbage trucks with hopper volumes of 60 m³ and more, the development of technologies production of cars with multi-section bodies,

These measures are a prerequisite for increasing the technological and economic efficiency of waste management systems both at the local and regional levels.

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