ТЕХНИЧЕСКИЕ НАУКИ И ТЕХНОЛОГИИ

АҚПАРАТТЫҚ ЖҮЙЕЛЕР
ИНФОРМАЦИОННЫЕ СИСТЕМЫ
INFORMATION SYSTEMS

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ASSESSMENT OF DISTRIBUTION SYSTEM CONSIDERING PRODUCTION AND CONSUMPTION WASTE BASED ON REMOTE SENSING DATA AT THE TERRITORY OF PAVLODAR CITY

ПАВЛОДАР қ. АУМАҒЫНДА ЖЕРДІ ҚАШЫҚТЫҚТАН ЗОНДТАУ ДЕРЕКТЕРІ БОЙЫНША ӨНДІРІС ЖӘНЕ ТҰТЫНУ ҚАЛДЫҚТАРЫНЫҢ ТАРАЛУЫН БАҒАЛАУ

ОЦЕНКА РАСПРОСТРАНЕНИЯ ОТХОДОВ ПРОИЗВОДСТВА И ПОТРЕБЛЕНИЯ ПО ДАННЫМ ДИСТАНЦИОННОГО ЗОНДИРОВАНИЯ ЗЕМЛИ НА ТЕРРИТОРИИ г. ПАВЛОДАРА

Abstract. On this article we introduced the results of research on distribution and accumulation of production and consumption waste in the territory of Pavlodar, namely, to identify impromptful landfills (unauthorized disposal). The impromptful landfills were identified using a space monitoring method. This work was carried out jointly with JSC «NC «Kazakhstan Gharysh Sapary». Space monitoring was brought into action by a remote sensing system for layers of the earth's surface. Space images were obtained from satellite KazEOSat-1, which include a number of indicators, characterizing impromptful landfills – area, date and time, types of waste (authorized, unauthorized, going beyond boundaries of the authorized) and license boundaries of domestic and industrial waste landfills. As a result of the research and analysis on the data obtained, we concluded that there are more unauthorized landfills in the eastern part of Pavlodar than in the western part. In future, it is necessary to strictly observe the measures for their timely liquidation.

Key words: remote sensing, space monitoring, production and consumption waste, authorized and unauthorized landfills.

Аңдатпа. Бұл мақалада Павлодар қ. территориясында өндіріс және тұтыну қалдықтарының таралуы мен шоғырлануы, яғни апаттық қоқыс орындарын (рұқсат етілмеген қоқыс орындарын) анықтау бойынша зерттеулер нәтижесі ұсынылған. Апаттық қоқыс орындары ғарыштық мониторинг әдісі арқылы анықталды. Бұл жұмыс «Қазақстан Ғарыш сапары» ҰК» АҚ-мен бірлесіп жүргізілді. Ғарыштық мониторинг жер бетінің қабаттарын қашықтықтан зондтау жүйесімен жүзеге асырылды. KazEOSat-1 спутнигінен ғарыштық суреттер алынды, олар апаттық қоқыс орындарын сипаттайтын көрсеткіштер қатарын қамтыды – аумағы, күні мен уақыты, қалдықтардың түрлері (рұқсат етілген, рұқсат етілмеген, рұқсат етілген шекарадан шығу) және тұрмыстық және өндірістік қалдықтар полигондарының лицензиялық шекаралары. Жүргізілген зерттеулер мен алынған деректерді талдау нәтижесінде біз Павлодар қаласының батыс бөлігіне қарағанда шығыс бөлігінде рұқсат етілмеген қоқыс орындары көп деген қорытындыға келдік. Алдағы уақытта оларды уақтылы жою жөніндегі іс-шараларды қатаң ұстану қажет.

Түйін сөздер: қашықтықтан зондтау, ғарыштық мониторинг, өндіріс және тұтыну қалдықтары,

рұқсат етілген және рұқсат етілмеген қоқыс орындары.

Аннотация. *В данной статье представлены результаты исследований по распространению и скоплению отходов производства и потребления на территории г. Павлодара, а именно по выявлению стихийных свалок (несанкционированных свалок). Стихийные свалки были идентифицированы с помощью метода космического мониторинга. Данная работа проводилась совместно с АО «НК «Қазақстан Гарыш сапары». Космический мониторинг осуществлялся системой дистанционного зондирования слоев земной поверхности. Со спутника KazEOSat-1 были получены космические снимки, которые включают в себя ряд показателей, характеризующих стихийные свалки – площадь, дата и время, типы отходов (санкционированный, несанкционированный, выход за границы санкционированного) и лицензионные границы полигонов бытовых и промышленных отходов. В результате проведенных исследований и анализа полученных данных нами был сделан вывод, что в восточной части г. Павлодара больше несанкционированных свалок, чем в западной. В дальнейшем необходимо строго соблюдать мероприятия по их своевременной ликвидации.*

Ключевые слова: *дистанционное зондирование, космический мониторинг, отходы производства и потребления, санкционированные и несанкционированные свалки.*

Introduction. Due to the growing population on surface, the size of production and consumption waste generation will be increased, this leads to contamination of structural parts considering the biosphere with harmful substances: the atmosphere, hydrosphere and lithosphere [1, 2]. In turn, this influences disruption of various ecosystem services, a decrease in the fertility of soil cover, biodiversity of plant and animal world and other adverse consequences. Therefore, the Sustainable development purposes of the Republic of Kazakhstan include the aim named «Ensuring the transition to optimal patterns of consumption and production». For this purpose, tasks have been approved and designed to solve the issues of collection, disposal, rational sorting of production and consumption waste per capita [3]. In this regard, to optimally solve the problem of waste, the system of environmental documents was revised, and classification of production and consumption waste and peculiarities of accumulation, collection and management received a new idea in legislative acts.

New Environmental code of the Republic of Kazakhstan and other documents regulating environmental relations developed in 2021 provide the development of waste reclamation technologies (plastics, waste paper and other materials) in solving environmental problems, emphasis on general economic services, moreover the introduction of circular production chains [4, 5, 6]. This has a direct impact on the functions of waste accumulation and management, as well as the main project for creating landfills for solid household waste with the accumulation of waste in accordance with sanitary and hygienic standards, harmless requirements for environmental indicators. These are:

– reduction considering the negative impact of waste on the environment;

– minimize the impact of enterprise wastes on environmental components at all stages of their handling;

– compliance with waste management requirements regulated by obligatory legal and legislative acts of the Republic of Kazakhstan and technological regulations;

– inventory of production and consumption wastes on the enterprise and ways of their formation in order to fulfill the above points.

However, along with the issues of waste collection, their formation is of great importance, from which it follows that the presence of solid waste landfills cannot completely prevent the formation of waste.

Therefore, together with the national company «Kazakhstan Gharysh Sapary», during the year monitoring was initiated not to exceed the licensed boundaries of unauthorized, permitted landfills by remote sensing. This company, along with interested state bodies, has developed an interdepartmental action plan for the adoption of systemic measures to eliminate and prevent natural landfills, and is conducting space monitoring of waste disposal sites and raids «Taza

Kazakhstan». In 2020–2021 years according to the reports of «Kazakhstan Gharysh Sapary», the following statistics were obtained on state of production and consumption waste. According to the results of space monitoring in 2020, 8884 unauthorized landfills were identified, out of which 7147 landfills were liquidated (including those, which were not removed in 2019), and takes 80 % overall (in 2019 – 28 %, in 2018 – 14 %). The highest concentration of waste was noted in Akmola region – 1527, out of which 742 landfills – 49 %, in Almaty region – 688, out of which 307 landfills – 45 %, in the Turkestan region – 404, out of which 122 landfills – 30 %, West Kazakhstan region – 419, including 204 landfills – 49 %, 488 were liquidated in Pavlodar region, out of which 54 landfills – 11 % [7].

From this it is obvious that the problem of waste is relevant, which has not yet been fully resolved. Purpose of study is to assess the spread of production and consumption waste in the city of Pavlodar according to data of remote sensing on the Earth.

Methods and materials. «Remote sensing» method is currently used to determine and classify terrestrial, atmospheric and ocean objects using satellite technologies [8, 9]. Orbital platforms collect and transport data from various parts of the electromagnetic spectrum, which is used in areas such as natural resource management [10, 11], land use [12, 13] and environmental protection and control [14]. The correctly organized remote research system is focused on solving specific geological problems that determine the choice of orbits cobsidering space carriers, a set of sensors, nature of the collection, processing and transmission of initial data to ground complexes and the type of materials provided [15, 38-39 pp.].

Form of research – territory of Pavlodar city. During monitoring, space images were taken with a KazEOSat-1 satellite (1 m) in a remote sensing system. In the space photo:

– location of unauthorized landfills in the form of a schematic map with an area of at least 2 m2 (indicating the regional environmental departments corresponding to this region);

– geographical coordinates of unauthorized landfills (slope, longitudinal, region, zone);

– date, time, area of detected unauthorized debris;

– name of space system with a photograph of the corresponding land plot;

– type of waste: unauthorized (in the absence of licensed boundaries on landfill); permitted (in case of waste receipt to the license boundaries on landfill); travel abroad (in case of waste removal from the licensed boundaries on landfill);

– licensed boundaries on landfills of domestic and industrial waste.

Depending on area occupied by the emergency dumps, their space images are taken on various scales:

– scale of space pattern on landfills № 1 and № 2 – 1:1000;

– scale of space pattern on landfills № 3, № 4, № 5 – 1:1933;

– scale of space pattern on landfill № 6 – 1:2000;

– scale of space pattern on landfills № 7, № 8 – 1:1500;

– scale of space pattern on landfills № 9, № 10 – 1:2000;

– scale of space pattern on landfill № 11 – 1:1000;

– scale of space pattern on landfills № 12, №13, № 14, № 15, № 16 – 1:2000;

– scale of space pattern on landfills № 17, № 18 and № 19 – 1:8000;

– scale of space pattern of landfills № 20–25 – 1:12500;

– scale of space pattern of landfill № 26 – 1:4000;

– scale of space pattern of landfill № 27 – 1:2000.

Research results. When conducting space monitoring on the territory of Pavlodar region, at a distance of 2.5 km east of the village of Krasnoarmeika in the eastern part of Pavlodar, there is a permitted landfill for production and consumption waste: 52°22'14" N at north latitude

77º17'45" at east longitude (Figure 1). This landfill will receive solid household waste in the city.
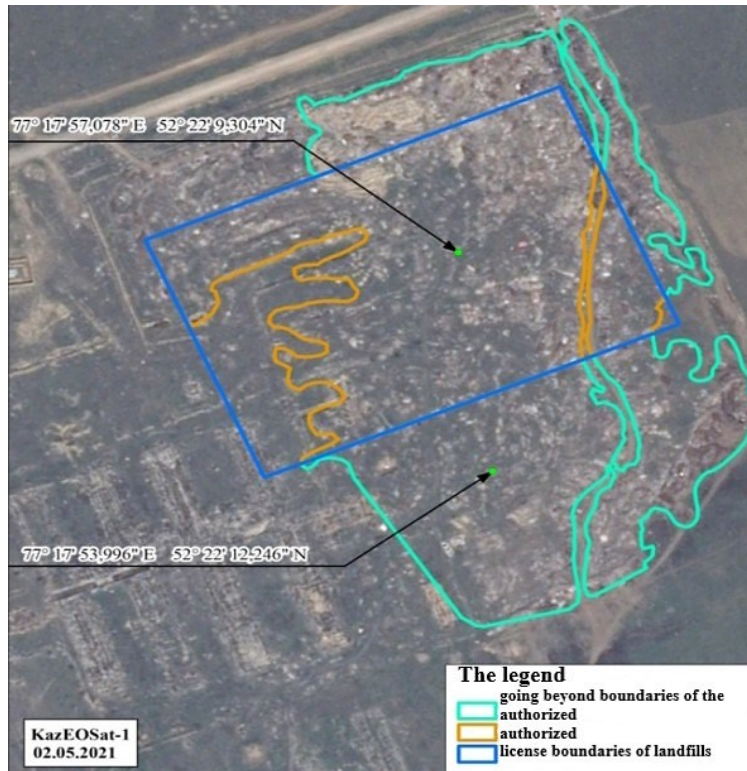
Figure 1. Permitted landfill for production and consumption waste in Pavlodar region

Based on space images, unauthorized landfills were identified in the eastern and northeastern parts of the Pavlodar city. It was noted that emergency landfills in the north-east zone occupy a small area, and emergency landfills in the east – a large area.
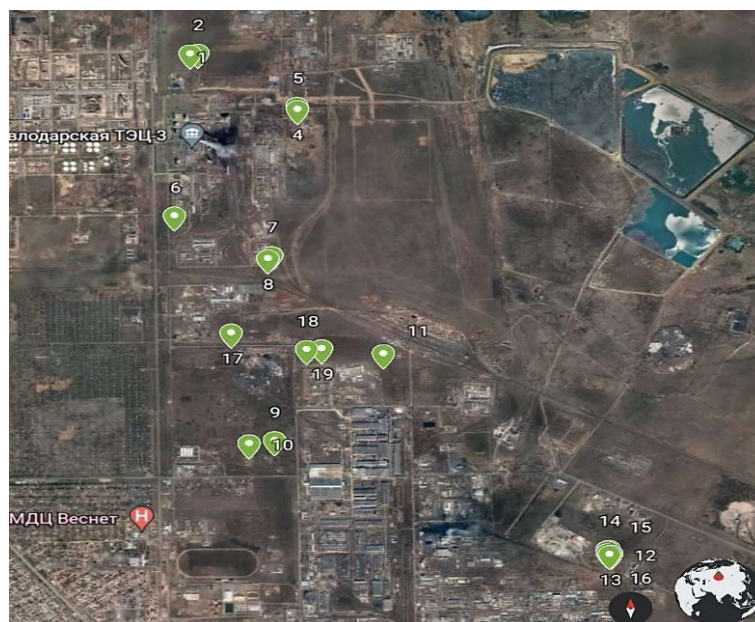
Figure 2. Emergency landfills identified in the north-eastern part of Pavlodar

In the northeastern part of the city (Figure 2):

1) unauthorized landfills № 1 and № 2 at a distance of 1 km north of the territory of Pavlodar CHP-3, and in the south - unauthorized landfills № 6 at a distance of 1 km;

2) unauthorized landfills № 3, № 4, № 5 as a result of space monitoring from the back of Pavlodar cardboard-ruberoid plant;

3) unauthorized dumps № 7 and № 8 at a distance of up to 800 m south of the Pavlodar cardboard-ruberoid plant, garbage dumps № 18 and № 19 at a distance of 2 km, and № 17 at a distance of 1.8 km;

4) unauthorized landfills № 11, and at a distance of 400 m – № 9, № 10, identified at a distance of 1.5 km north of the KPSteel industry;

5) about 1.5 km from the northern industrial zone there are unauthorized landfills № 12, № 13, № 14, № 15, № 16.

And in the eastern part of Pavlodar, emergency landfills № 20–27 were identified. Out of these, unauthorized landfills are № 20, № 21, № 22, № 23, № 24 and № 25, which occupy a large territory, and located south of the Suvorov cemetery. Also, these landfills were not located away from the premises, that is, they were observed at a distance of 700-800 m (Figure 3).

Figure 3. Emergency landfills covering a large area in the eastern part of Pavlodar

As of May 1, 2022:
– area of landfills №20-22 – about 37 094 m2;
– area of landfills №23-24 – about 60 894 m2;
– area of landfill №25 – about 75 700 m2.

In a monitoring review of these landfills on the morphological composition of waste, it was shown that they consist of construction waste, solid household waste and soil landfills and dust (Figure 4).

Figure 4. Snapshot from landfill № 25

Solid household waste and soil landfills from the territory are formed as a result of the production and economic activities of enterprises and population of the Pavlodar city.

Due to the fact that new housing has been built on the territory of these landfills, construction waste prevails: concrete, brick, tiles and ceramics, trees, glass, plastics, ballasts and soils. In addition, due to the close location of the premises and cemetery, solid household waste prevails: plastics, rubber, waste paper, artificial flowers made of plastic and textiles.

One of the places of people's mass gathering in Pavlodar at a distance of 650 m outside the shopping and entertainment center «Batyrmall» installed an unauthorized landfill № 26, the area of which is about 14,600 m2. Landfill № 27, which occupies a small area in the extreme region of Pavlodar, was also identified (Figure 5).

Figure 5. Space image of emergency landfills in a small area at east of Pavlodar city

Conclusion. As a result of space monitoring, the number of identified unauthorized landfills in Pavlodar is 27 places. Landfills were found near production areas located in the northeastern part of Pavlodar city, and in the eastern part near the shopping and entertainment center, near the Suvorov cemetery and on the outskirts of city.

But we have identified emergency landfills covering a large area from the expenditure part:

1) landfills № 20-22 – an area of about 37 094 m2;

2) landfills № 23-24 – an area of about 60 894 m2;

3) landfill № 25 – covers an area of about 75 700 m2.

Summing up, the distribution of production and consumption waste is more concentrated in the eastern part of Pavlodar than in the western part.

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