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Ecological and economic analysis of the impact of railway transport enterprises on the environment: (on the example of the branch of JSC «NC» Kazakhstan Temir Zholy)

Abstract. *The impact of rail transport on the environment is one of the major problems in the Republic of Kazakhstan. It is well known that railway transport causes enormous harm to the environment, destroying natural relief during the construction of railways, pollution of water and air objects also creates physical pollution for people, and the operation of wagons and the transport of hazardous substances can lead to a high degree of pollution and land degradation. This study was aimed at identifying the ecological and economic problems of railway transport in the territory of the Republic of Kazakhstan. For the analysis, materials and data on environmental protection were collected. The results showed that reducing the impact on the environment was achieved through measures of environmental legislation. This concerned the reduction of the use of liquid and solid fuels, the equipping of emission sources with the necessary purification equipment, the reconstruction of environmental protection facilities, and the development of regulatory and environmental documentation. Based on this, it is shown that the use of environmental technologies for practical purposes can ensure the effective functioning and operation of a natural resource user enterprise from an environmental and economic point of view.*

Keywords: *railways, ecosystem destruction, economic damage, emission charges, asset values, environmental protection measures.*

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Introduction

Environmental protection is one of the most urgent problems facing humanity in connection with the increasing intensity of industrial and agricultural production, which leads to global changes with difficult predictable consequences.

In any socio-economic formation, the economy cannot be considered effective if labor potential is destroyed, resources are inefficiently used, obsolete technology, and air, water bodies, and soil are polluted. It leads to ecological and economic contradictions between the production growth of material goods, anthropogenic impact on the environment the natural environment, the value of environmental costs, the introduction of waste-free technologies, etc.

At this stage of development of the productive forces, economic interests dominate the environment, which leads to negative consequences in the relationship between society and nature. Needed a systematic approach in which the interaction of three groups of factors - natural, production, and social, provides a permissible anthropogenic load on the biosphere. The natural environment is a combination of ecological systems - extremely complex dynamic formations, for a long time in a state of internal balance. However, the development of industrial production and transport has such a significant human impact on environmental systems, which the latter increasingly becomes incapable

neutralize this impact, which leads to the emergence of a global ecological crisis.

The main indicators characterizing the impact of economic activities on the natural environment and use of natural resources include:

- emission of harmful substances into the atmospheric air from stationary and mobile sources;
- excessive abstraction of water from surface and underground sources;
- discharge of contaminated wastewater not only into treatment structures, but also directly into water bodies and on the terrain;
- land pollution due to their non-agricultural use, waste generation during mining, enrichment of useful minerals, and industrial production [1].

Additional costs of society for environmental protection of the natural environment from its production activities are associated with:

- direct costs for nature protection, cleaning air and water basins, disposal and disposal of solid waste;
- losses associated with the need for redundancy in order to nature protection of those facilities that could be operated and bring real economic results;
- additional costs in connection with the development of natural resources in the worst mining and geological conditions and more remote places;
- increased costs for recycling and low high-quality raw materials (waste);
- costs for fundamental and applied scientific research and development work related to security, rational use and restoration of renewable natural resources, and mastering new technological processes.

Economic damage from environmental pollution environment is due to additional costs for:

- healthcare - medical services, sick pay sheets, loss of products (services) due to an increase in the incidence in zones of increased environmental hazard;
- agriculture - losses in crop production, animal husbandry, and forestry due to the withdrawal from agricultural turnover of land for industrial and transport construction;
- industry - due to staff turnover, repair costs, and restoration of fixed assets;
- diversion of financial resources to environmental protection of the natural environment from other spheres of economic and social activities [2].

All this aggravates the ecological situation in Kazakhstan, which is experiencing excess man-made impact due to the nature of existing industrial enterprises and betrays the problem of researching the possibilities of management improvement of the natural environment of particular relevance.

Increasing volumes of transportation of raw materials, semi-finished products, and finished products require additional development of vehicles, from which the leading place is and will be for a long-time railway (mainline and industrial) transport.

Materials and research method

The length of the main railway lines is more than 14 thousand km, the main part (97.5%) of the railway network is located in the territory of Kazakhstan, 2.5% - in the territory of the border regions of Russia and Kyrgyzstan. There are 720 stations and passing points along the road [3]. The freight car fleet is more than 120,000 units, the locomotive fleet is more than 1,200 units, 609 of which are updated and modernized [4]. Traction rolling stock includes diesel locomotives, electric locomotives, electric trains, diesel trains, railcars, railcars, and other self-propelled equipment. Non-traction rolling stock - various cars (passenger, freight, tank cars).

Provides 70% of freight and 60% of passenger traffic annually [3].

The unfavorable environmental situation is aggravated by the work of railway transport enterprises - locomotive and carriage depots, stations, track distances, subdivisions of water supply and sewerage, and fronts of the production of loading and unloading operations.

Due to more accurate accounting, the number of sources of emissions of harmful substances into the atmosphere on the railway increased from 8710 in 2018 to 9254 in 2019, or by 61.3%. The volume of emissions themselves decreased from 8624 tons/year in 2017 to 7960 tons/year in 2016 - by 13.4%.

Reducing the impact on the environment was achieved through the implementation of measures to comply with environmental legislation. They related to reducing the use of liquid and solid fuels, equipping emission sources with the necessary purification equipment, reconstruction of environmental protection facilities, and developing regulatory and environmental documentation.

So, at the boiler houses of Temir Zholy Kostanay LLP, dust and gas cleaning equipment was installed, in Lokomotiv JSC, oil-containing soils are cleaned with a special biological solution, at Akzhaiyk station, the drainage system of buildings in the city was overhauled with a road administration and a machine counting station. In addition, the station "Kazievka" of the East Kazakhstan branch of the road was transferred to electric heating, and at the locomotive repair of the station "Kostanay" the sewerage was adjusted, and an oil collector was installed.

As a result, the amount of fines and excess payments imposed over the past year has been reduced by 46% compared to 2019.

A similar situation takes place with wastewater discharges into water bodies and waste generation. The most environmentally hazardous facilities for railway transport are washing and steaming points for liquid rolling stock, disinfection points for cars for transporting animals and biologically hazardous substances, sleepers and crushed stone plants, rolling stock, transporting oil products, etc.[5]

Environmental safety is also violated by physical factors from the functioning of railway transport facilities: noise, vibration, electric and electromagnetic fields, explosions, fires, insufficient strength of the ballast of the railway track, etc.[6]

All of this determined the purpose of the study - the analysis of the actual environmental hazard of railway transport facilities and the development of recommendations for its reduction.

Environmental safety is understood as the conditions under which there are no factors leading to a violation of the environmental equilibrium in the natural environment, causing a stress state in the relationship between society and nature, and influencing the habitat of living organisms.

To achieve this with the current level of technology and technology almost impossible. For a combination of economic and environmental interests of the enterprise and society use environmental standards - maximum permissible concentration (MPC) of harmful substances and emissions (MPE), norms of green areas that define the boundaries of permissible anthropogenic loads on the natural environment.

Results

The main share of emissions of harmful substances into the atmosphere from stationary sources of railway transport accounted for boiler houses operating on solid fuel - 25% and civil service enterprises - 36.7%, the locomotive - 25.3%, and wagons depot - 9.8%.

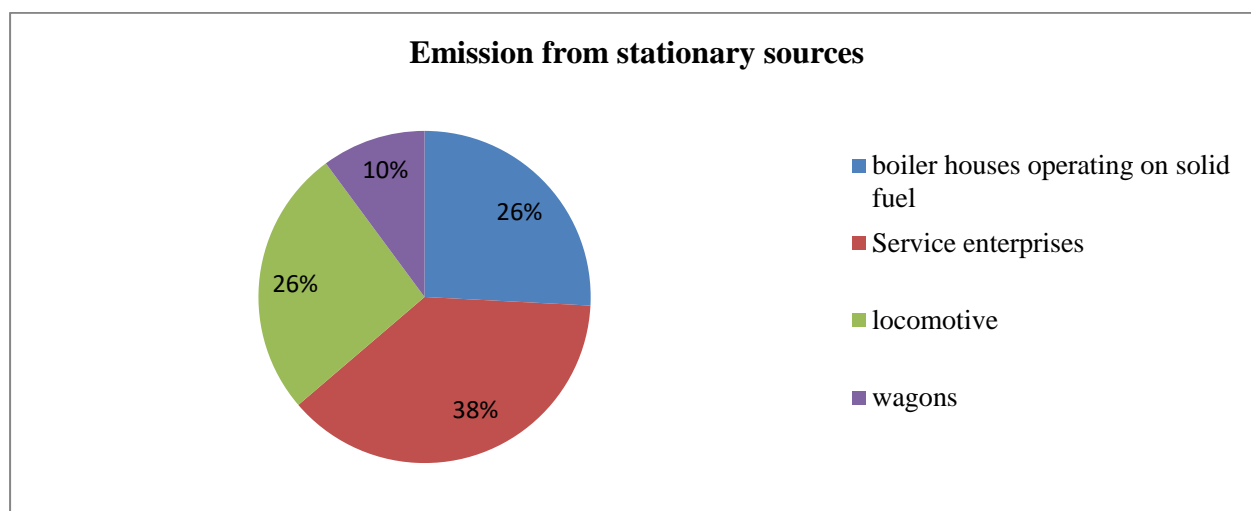


Figure 1. The types of emission from stationary sources

The volumes of emissions of harmful substances into various environments, the cost of fixed production assets for environmental protection, the costs of their operation, payments for emissions, discharges, and disposal of solid waste are shown in Table 1. They show that since 2017 Kazakhstan railway began to pay more attention to the implementation of measures for the protection of the natural environment. This was reflected, first of all, in a decrease in air emissions in 2018 compared to 2017 by 18.9%, incl. gaseous and liquid hazardous substances by 44.7%. A significant reduction in solid waste is due to a change in the method of accounting. The cost of fixed assets for environmental protection increased by 15.3%, and the cost of capital repairs and current maintenance increased 5, 1 time due to the slow pace of their renewal.

Environmental charges sharply increased both within the limit and above it, which led to an increase in costs for this item in 2019 by 7.5 times compared to 2018 and 5.2 times compared to 2017 of the total environmental charges, 49.5% fall on mobile sources (diesel locomotives, cars) and 46.2% on stationary ones, and this ratio remains stable throughout the period under consideration.

Table 1
Main indicators of work on environmental protection on the Kazakhstan railway

Indicator names	2013	2014	2015	2016	2017	2018	2019
Air emissions, <i>t.</i>	6689	7989	7340	7960	8624	8710	9254
of which solids	2267	2461	2803	2680	3100	3565	3905
gaseous and liquid	4401	6590	6637	6100	4902	4245	3530
Wastewater discharges, <i>thousand m.</i>	5236	3570	3302	3155	4237	3785	3578
incl. down the drain	2535	1766	1639	1470	2364	2222	1968
into water bodies	2729	1824	1672	1649	1891	1474	1401
Solid waste generation, <i>t.</i>	50500	42500	31000	36700	29100	6994*	7808*
The average annual cost of fixed assets for environmental protection, <i>million tenge</i>	5405	10467	11543	12567	13445	14569	14580

Overhaul costs, <i>million tenge</i>	4	5	6	7	8	-	3
Operating costs for environmental protection measures, <i>million tenge</i>	3633	5902	6000	6438	6905	7120	7230
Fee for emissions, discharges, waste disposal, <i>million tenge</i>	6	7	7.5	8	9**	9.8**	10.3**
incl. into the atmosphere from stationary sources	246	252	292	320	482	507	1102
into the atmosphere from mobile sources	158	303	296	375	587	529	1098
into water bodies	15	17	18	19	21	21	41
placing waste on the ground	53	60	69	80	85	105	165

* - solid waste

** - a sharp increase in payments for environmental discharges is due to the indexation of collection rates and the inflation index

Discussion

JSC NC "KTZh" carries out long-term and current planning in the field of environmental protection. Within the framework of long-term planning, investment projects "Ensuring environmental safety", and "Implementation of resource-saving technologies in railway transport", as well as there were developed investment projects of individual departments, offices, branches of JSC NC "KTZh".

The need for such a program and project are due to the diversity sources of pollution, the physical and chemical composition of harmful substances emitted into the atmosphere, water bodies, and land, limited resources, and prioritization of using them to protect the environment as much as a possible natural environment.

The aim of the program is to establish a sequence and scope of work for the implementation of a set of activities, which will ensure the reduction of emissions of harmful substances into the environment and the natural environment and bring their concentrations to acceptable values.

It includes the following organizational and technical measures:

- the creation of an environmental management system aimed at centralized provision of road enterprises with legislative and regulatory documents on environmental protection and control over their implementation;

- ensuring the effective functioning of regional laboratories and their re-equipment with modern complexes measuring equipment for monitoring the composition of the atmosphere, pollution wastewater, soil, electromagnetic, noise, vibration pollution;

- protection of atmospheric air by equipping dust collectors and cyclones for solid fuel boilers, creation of ecological diagnostic laboratories in locomotive depots roads, the use of gas analyzers for vehicle exhaust gases, transfer to electric heating of passenger cars;

- protection and rational use of water resources by construction and reconstruction of biological treatment facilities, recycling water supply systems, storm sewers, sample analysis water, etc.;

- land protection and rational use of natural plant resources through the inventory of waste and obtaining permits for their location, development of passports for oil sludge sites, purchase of a plant

for processing lubrication, improvement and landscaping of the railway, maintenance forest plantations;

- training and professional development of specialists in the field of environmental protection for the railway industry.

The implementation of the planned set of measures requires the performance of research works incl. development of technological processes and equipment samples to reduce emissions of harmful substances and their neutralization, ways to reduce pollution of the natural environment in case of transport accidents, technologies industrial waste processing, and modern system environmental monitoring at railway enterprises.

Conclusion

The research carried out allows us to formulate the following directions for preserving and improving the state of the surrounding natural:

- rail transport contributes to the deterioration the state of the natural environment, which economically affects on the financial indicators of his work. However, one should expect a more significant increase in environmental charges when legislative acts on this issue will fully work;

- it is necessary to carry out automatic monitoring for emissions of harmful substances into the atmosphere from permanent sources;

- more cost effective use of the mechanism environmental control and management at enterprises railway transport;

- develop and implement technological processes and production equipment that has minimal harmful impact on the natural environment, saving natural resources;

- create closed systems for water use, recuperation air, rational schemes for collection, storage and disposal toxic waste

- continue the implementation of the planned set of measures for environmental protection, providing them with planned financial, labor and material resources.

The practical implementation of these activities will contribute to improving the environmental situation in the Republic Kazakhstan due to reduction of harmful emissions by railway enterprises transport.

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Теміржол көлігі кәсіпорындарының қоршаған ортаға әсерін экологиялық-экономикалық талдау: («Қазақстан темір жолы» ҰК»АҚ филиалы-«Магистральдық желі дирекциясы мысалында»)

Аңдатпа. Темір жол көлігінің қоршаған ортаға әсері Қазақстан Республикасындағы негізгі мәселелердің бірі болып табылады. Темір жол көлігі қоршаған ортаға орасан зор зиян келтіріп, темір жол құрылысы кезінде табиғи рельефті бұзып, су және ауа объектілерін ластайды, сонымен қатар адамдардың физикалық ластану әсерін тигізеді, ал вагондарды пайдалану және зиянды заттарды тасымалдау кезінде топырақтың ластануына және жердің деградациясына әкеп соғады. Бұл зерттеу Қазақстан Республикасы аумағындағы темір жол көлігінің экологиялық және экономикалық мәселелерін анықтауға бағытталған. Талдау үшін қоршаған ортаны қорғау бойынша керекті материалдар мен деректер жинақталды. Нәтижелер бойынша қоршаған ортаға әсерді азайтуға экологиялық заңнамалық шаралар арқылы қол жеткізілгенін көрсетті. Бұл сұйық және қатты отынды пайдалануды азайтуға, шығарындылар көздерін қажетті тазарту жабдықтарымен жабдықтауға, қоршаған ортаны қорғау объектілерін қайта құруға, нормативтік және экологиялық құжаттамаларды әзірлеуге қатысты. Осының негізінде экологиялық технологияларды практикалық мақсатта пайдалану экологиялық-экономикалық тұрғыдан табиғат пайдаланушы кәсіпорынның тиімді жұмыс істеуі мен қызметін қамтамасыз ете алатыны көрсетілген.

Түйін сөздер: темір жолдар, экожүйені бұзу, экономикалық зиян, эмиссия төлемдері, активтердің құны, қоршаған ортаны қорғау шаралары.

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Эколого-экономический анализ воздействий предприятий железнодорожного транспорта на окружающую среду: (на примере филиала АО «НК «КТЖ»-«Дирекция магистральной сети»)

Аннотация. Воздействие железнодорожного транспорта на окружающую среду является одной из основных проблем в Республике Казахстан. Известно, что железнодорожный транспорт наносит огромный вред окружающей среде: при строительстве железных дорог разрушается природный рельеф, загрязняются водные и воздушные объекты, происходит физическое загрязнение людей, а эксплуатация вагонов и перевозка вредных веществ могут привести к высокой степени загрязнения и деградации земель. Данное исследование было направлено на выявление эколого-экономических проблем железнодорожного транспорта на территории Республики Казахстан. Для анализа были собраны материалы и данные по охране окружающей среды. Результаты показали, что снижение воздействия на окружающую среду было достигнуто за счет мер природоохранного законодательства. Это касалось сокращения использования жидкого и твердого топлива, оснащения источников выбросов необходимым очистным оборудованием, реконструкции природоохранных объектов, разработки нормативной и природоохранной документации. На основании этого показано, что использование природоохранных технологий в практических целях может обеспечить эффективное функционирование и деятельность предприятия-природопользователя с эколого-экономической точки зрения.

Ключевые слова: железные дороги, разрушение экосистем, экономический ущерб, плата за выбросы, стоимость активов, меры по охране окружающей среды.

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