MODERN SCIENCE: INNOVATIONS AND PERSPECTIVES

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ORGANIZERS

1. Ministry of Education and Science of Ukraine;
2. Kyiv Institute of Railway Transport of the State University of Infrastructure and Technologies, Ukraine;
3. Ukrainian State University of Railway Transport, Ukraine;
4. Volodymyr Dahl East Ukrainian National University, Ukraine;
5. Academy of Applied Sciences, Ukraine;
6. University of Žilina, Slovak Republic;
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The collection of conference materials is a scientific and practical publication, which contains scientific articles of students, graduate students, candidates and Doctors of Science, scientists and practitioners from Ukraine, Europe and other countries. Articles contain researches of modern innovative processes in science. The collection is intended for approbation of scientific research by bachelors, masters, graduate students, doctoral students, teachers and scientific researchers, as well as to expand the scientific horizons of researchers from relevant fields of knowledge and inform a wide range of scientists and practitioners about the existing modern problems in various fields.

The materials are presented in the author's edition

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М А Т Е Р І А Л И

Міжнародної мультидисциплінарної **науково-практичної інтернет-конференції молодих дослідників, здобувачів вищої освіти та науковців**
«СУЧАСНА НАУКА: ІННОВАЦІЇ ТА ПЕРСПЕКТИВИ»
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Конференція внесена до плану Міністерства освіти і науки України у 2023 році та зареєстрована в ДУ «Український інститут науково-технічної інформації» (УкрІНТЕІ) за № 16 від 16.01.2023р.

Сучасна наука: інновації та перспективи: Матеріали Міжнародної мультидисциплінарної науково-практичної інтернет-конференції молодих дослідників, здобувачів вищої освіти та науковців 6-7 квітня 2023р. м. Київ, вид-во: Київський інститут залізничного транспорту Державного університету інфраструктури та технологій, реєстр. УкрІНТЕІ №16 від 16.01.2023, 2023. 452 с.

Голова оргкомітету конференції:
Губаревич О.В. – к.т.н., доцент кафедри електромеханіки та рухомого складу залізниць Київського інституту залізничного транспорту Державного університету інфраструктури та технологій

Відповідальний секретар конференції:
Голубєва С.М. – ст. викладач кафедри суднових енергетичних установок, допоміжних механізмів суден та їх експлуатації Київського інституту водного транспорту Державного університету інфраструктури та технологій

До електронного збірника увійшли матеріали доповідей, поданих на Міжнародну мультидисциплінарну науково-практичну інтернет-конференцію молодих дослідників, здобувачів вищої освіти та науковців, яка організована Київським інститутом залізничного транспорту Державного університету інфраструктури та включена до плану Міністерства освіти і науки України.

Електронне наукове видання призначено для апробації наукових досліджень бакалаврів, магістрів, аспірантів, докторантів, викладачів та наукових співробітників, а також для розширення наукового кругозору дослідників з відповідних галузей знань, інформування широкого кола вчених та практиків щодо існуючих сучасних проблем у різних галузях та розвитку міжнародної співпраці.

Матеріали подано в авторській редакції

ЗМІСТ
TABLE OF CONTENTS

RESEARCH OF THE «GREEN» LOGISTICS TECHNOLOGIES IN TRANSPORTATION OF CARGO BY RAIL TRANSPORT

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The technology of carrying out international and domestic transportation of goods by using multimodal transportation – container and counter-trailer trains has been investigated. It has been established that these technologies have significant advantages in terms of reducing the negative impact on the environment compared to delivery by individual modes of transport. A brief description of the main environmental characteristics of multimodal delivery schemes is given and the negative impact of each mode of transport is assessed separately. The ways of further development of «green» logistics for rail transportation of goods over a distance of more than 300 km are proposed.

Keywords*: railway, «green» logistics, multimodal transportation, impact on the environment, air pollution, container, semi-trailer.*

Actuality. Experts claim [1] that transport accounts for 8% of all carbon dioxide emissions on the planet, and warehouses account for another 3%. In this regard, the wide implementation of «green» technologies in logistics activities will make a significant contribution to the preservation of the planet's climate, suitable for safe human activities. The development of multimodal transport involves the creation of a single system of functioning of the transport system, in particular railway and road, which allows for the implementation of transport services according to the «door-to-door» and «just-in-time» scheme. As a result, railcars, container trains and route container groups, as well as trains of combined transport, run on the railways of many countries.

The purpose of the work is a concise analysis of the state of multimodal transportation of goods with the participation of railways, consideration of the advantages and disadvantages of the operation of various types of transport and their impact on safety and the environment. Due to this, it is possible to organize multimodal or intermodal transportation in the form of «green» logistics supply chains.

Most emissions from moveable sources of pollution come from road transport. The share of railway, aviation and water transport in air pollution is insignificant. Thus, according to the State Statistics Service of Ukraine, for the period before the introduction of martial law into Ukraine, the excess of pollutant emissions into the atmospheric air from road transport compared to rail transport is 49 times.

Environmental restrictions on domestic transportation of goods by road are put forward in the state transport strategy [2], which assumes a decrease in the number of heavy trucks (container carriers) on long routes of more than 200 km. In EU countries, these restrictions are noted in the ECMT White Paper [4], according to

which the EU transport system aims to transfer 30% of road freight transport with a travel distance of more than 300 km to more environmentally friendly rail and inland water transport by 2030 year.

Taking into account [1, 4, 6], harmful emissions into the environment during the transportation of containers by various modes of transport were made:

• average specific emissions of harmful substances on electric railway trains CO_2 = 0.0033...0.0038 g/TEU*km, NOx = 0.8170...0.8174 g/TEU*km, SOx = 0.8696...0.8763 g/ TEU*km (with a mixed mode of electricity generation by fuel oil/coal power plants);

• average specific emissions of harmful substances during shunting work CO_2 = 320.50 g/TEU*h, NOx = 620.1 g/TEU*h, SOx = 93.50 g/TEU*h (CHME-3 locomotive in operating mode of the engine Ne = 75% of full power, the composition of the shunting crew is taken to be 10 wt.);

• average specific emissions of harmful substances during the transportation of containers by sea transport (on the example of the Emma Maersk container ship with a 14-cylinder diesel engine with a capacity of 80,800 kW) CO_2 = 8.1955... 13.3927 g/TEU*km, NOx = 2.5625... 4 ,1875 g/TEU*km, SOx = 1.8750... 3.0562 g/TEU*km (specific fuel consumption expertly accepted as 205 g/kWh);

• average specific emissions of harmful substances of the truck CO_2 = 13.194 g/TEU*km, NOx = 3.750 g/TEU*km, SOx = 3.200 g/TEU*km (6-cylinder diesel engine, average speed 60 km/h, full load container).

Thus, it has been proven that railway transport is the most ecological in terms of emissions of CO, NOx, SOx into the atmosphere. In fig. 1 shows a comparison of the specific pollutant impact on the environment during the transportation of a 20-foot container (TEU) with dangerous goods by different modes of transport.

In this context, all participants in freight transportation need to ensure environmental safety and environmental protection. This can be achieved by creating an environmental management system in accordance with the international standard DSTU ISO 14001 [3], which contains a system of measures related to: impact on the atmospheric air; impact of parametric pollution (noise, vibration); impact on soils; impact on water bodies; waste management.

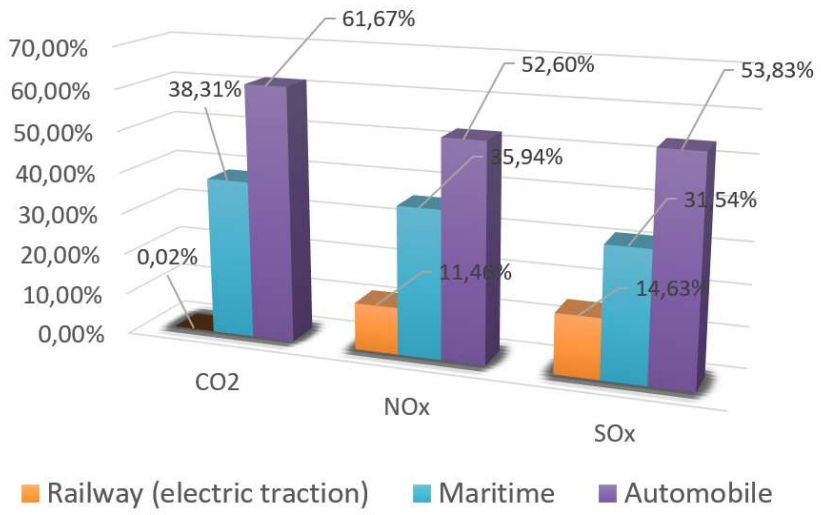

Figure 1 – Comparison of the specific pollutant impact on the environment when transporting a 20-foot container (TEU) with cargo by different modes of transport

The benefits of implementing an environmental management system and certification in accordance with DSTU ISO 14001 during transportation can significantly reduce the consumption of electricity and natural resources, reduce environmental taxes and create conditions for effective environmental risk management. Already now, in many spheres of the EU countries, logistics operators are required to have an ISO 14001 certificate as a prerequisite for cooperation. The assessment of the environmental performance of the railway, as part of the logistics chain, can be made based on the recommendations of the ISO/FDIS 14031:2021 standard [5], which allows determining structure of the carrier's operating activities and the factors that affect its environmental performance, processes of waste generation.

Strategies for the implementation of «green» logistics involve the reduction of harmful emissions from mobile sources. However, the growth in demand for freight transport is closely linked to economic growth, so in an era of rapid global economic development, there is a strong correlation between the reduction of carbon dioxide emissions and the demand for freight transport [6]. A number of foreign studies are related to the prospects for reducing CO_2 emissions by reducing and adjusting the demand for transportation using methods rational design of a logistics network, optimization of transport routes, application in freight transportation of road and railways electric transport [7].

On the other hand, scientific research within the framework of the global Shift strategies aimed at reducing CO_2 emissions is focused on the analysis of the behavior of shippers in choosing a delivery method. To justify the choice of the method of transportation by the consignor, the study is devoted to the transfer of the flow of goods from roads to railways due to the competitiveness of the railway and its better environmental performance. Thus, the prospect of «green» logistics in the field of rail

and other modes of transport can be linked to the requirements of international ISO standards and regulations, which are a recognized tool for creating an effective environmental management system. The development of multimodal transportation of goods contributes to the introduction of «green» logistics technologies in the process of gradually abandoning long-distance (over 300 km) road freight transportation.

Conclusion. The improvement of the technology for the implementation of international and domestic transportation of goods through the use of multimodal (container) trains is considered. It has been established that these technologies have significant advantages in terms of reducing the negative impact on the environment compared to the delivery of goods by individual modes of transport. From the point of view of «green» logistics, a brief description of the main types of air pollution is given. The negative impact of each type of transport separately and as part of a multimodal system on the environment was assessed. The ways of further development of «green» logistics for rail transportation of goods over a distance of more than 300 km are proposed.

R e f e r e n c e s

1. Naukovo-tekhnichni doslidzhennia u haluzi transportu: kolektyvna monohrafiia / Ed. D.V. Lomotko. Akademiia tekhnichnykh nauk Ukrainy. Ivano-Frankivsk: Vydavets Kushnir 2022. T 1. 216 s.

2. National transport strategy of Ukraine up to 2030 year. URL: ttp://zakon.rada.gov.ua/laws/show/430-2018-%D1%80.

3. ISO 14001:2015 Enviromental management systems – Requirements with guidance for use : ISO 14001:2015. URL: https://www.iso.org/obp/ui/#iso:std:iso:14001:ed-3:v1:en

4. The White Paper of the European Commission - a plan for the development of a single European transport space – on the way to a competitive and resource-efficient transport system. Publishing Center of the European Union in Luxembourg. 2011. 28c. doi:10.2832/30955

5. ISO/FDIS 14031:2021. Environmental management – Environmental performance evaluation – Guidelines. URL: https://www.iso.org/standard/81453.html

6. Matteo Muratori, Steven J. Smith at etc Role of the Freight Sector in Future Climate Change Mitigation Scenarios. Environmental Science & echnology 2017 51 (6), 3526-3533 DOI: 10.1021/acs.est.6b04515

7. L. Li, X. Zhang Reducing CO_2 emissions through pricing, planning, and subsidizing rail freight Transport. Res. Transport Environ., 87. 2020, Article 102483, DOI: 10.1016/j.trd.2020.102483