Afanasyeva, T. A. Justification of a set of measures to ensure a comfortable and safe living environment for humans in the context of functioning of transport systems. Abstract of Ph.D. (Eng) thesis [*Obosnovanie kompleksa meropriyatii dlya obespecheniya komfortnoi i bezopasnoi dlya cheloveka sredy obitaniya v usloviyakh funtsionirovaniya transportnykh sistem. Avtoref. dis… kand. tekh. nauk*]. Moscow, RUT (MIIT) publ., 2023, 20 p.

Currently, construction of residential areas and development of urban services are often followed by violation of measures to ensure environmental safety of living conditions of the population and lead to formation of zones of excess acoustic load in residential areas. Railway transport facilities are one of the most significant sources of excess noise levels in residential areas, residential buildings, and administrative premises.

The purpose of the thesis research was to develop a scheme for selecting activities that would provide the most comfortable and safe living environment for humans in areas with a developed transport system.

The object of the study was acoustic characteristics of rolling stock at the Oktyabrskaya Railway site. The subject of the study included measures to protect residential and public buildings from noise.

The understanding of the list of noise protection measures that affect safety of living conditions in cities and agglomerations in areas with developed transport infrastructure has been expanded. The list of noise protection measures for residential premises and public buildings includes soundproofing fabric. A study of its acoustic characteristics has been carried out, and methods of use have been proposed.

The scientific position is substantiated that the currently existing set of noise protection measures is insufficient to comply with hygienic requirements. It has been established that acoustic screens have limited effectiveness in the conditions of high-rise buildings in areas where linear railway transport facilities are located, as well as in the context of the prospect of intensive development of high-speed railway traffic.

Elements of technology for substantiating a set of noise protection measures have been developed to solve the problem of excess acoustic impact on the territory and residential premises in the area where linear railway transport facilities operate.

An information system, databases and an algorithm for substantiating management decisions have been created.

The insufficient effectiveness of the complex of currently existing noise protection measures used to normalise the acoustic load on residential areas and premises of residential and public buildings has been proven.

A set of measures has been proposed to reduce the acoustic load in residential and public premises located in the zone of excess acoustic influence of transport infrastructure facilities.

It is recommended to make changes to the regulatory documents regarding the requirements for double-glazed windows, because contrary to the requirements of SP [Construction rules] 31–107–2004, the regulatory and technical acts do not contain information on which window unit design has a particular degree of airborne noise insulation efficiency.

The research results may influence future development of the theory and practices of developing technical aids and means to reduce noise from traffic flows.

Methodological approaches to organising research and the developed scheme for selecting noise protection measures can be replicated for automobile and aviation transport systems.

Prospects for further development of the topic include a detailed study of soundproofing and sound-absorbing materials to ensure the acoustic safety of the environment.

2.9.10. Technosphere safety of transport systems (engineering sciences)
The work was performed and at Emperor Alexander I St. Petersburg State Transport University and defended at Russian University of Transport.

Konovalov, P. Yu. Improvement of pneumatic sand supply systems for locomotives and improvement of their operational performance. Abstract of Ph.D. (Eng) thesis [*Sovershenstvovanie pnevmaticheskikh sistem peskopodachi lokomotivov i uluchshenie ikh ekpluatatsionnykh pokazatelei. Avtoref. dis… kand. tekh. nauk*]. Rostov-on-Don, RGUPS publ., 2023, 24 p.

Today, new locomotives with improved traction properties are being actively designed and implemented. Thus, locomotives are equipped with additional loading devices and inclined rods to compensate for redistribution of coupled weight, with an asynchronous traction drive with axial traction control, which has more rigid traction characteristics, and others. However, despite the innovative solutions of new promising series of locomotives, in operation there are still negative phenomena associated with excessive slipping of the driving wheels of locomotives – slipping in traction mode and skidding during braking, especially in difficult coupling operating conditions. This is due to a wide range of changes in the friction coefficient in the contact zone of locomotive wheels with the rail, which depends on a large number of factors in operation, such as: the presence of industrial pollution and moisture on the surface of the rail, weather and climatic conditions, speed, weight of the train, the complexity of the profile and layout of the railway track, the design features of the rolling stock and many others.

The most common way to increase the adhesion of driving wheels to rails on railway rolling stock is to supply quartz sand particles in a stream of compressed air. Despite the fact that these systems are widespread and used in pumping stations of various types and purposes, they still have low operational reliability and disadvantages – fixed seasonal adjustment of sand flow, the use of pulse control of supply with different pulse duty ratios, a tendency for the sandbox nozzles used to self-deregulate and excessive uncontrolled supply of sand, low flow rate of the sand-air mixture, which leads to blowing of sand particles by a side wind flow during transportation from the outlet section of the bedding hose to the wheel-rail adhesion zone.

The objectives of the study are to improve the basic elements of locomotive sand supply systems for smooth continuous dosing of sand and improve their performance indicators.

The object of the study was the pneumatic sand supply system of a locomotive for transporting quartz sand particles to the contact zone of the locomotive wheels with the rails in a stream of compressed air.

The direction of the research was to improve the operational performance of sand supply systems for locomotives by improving its main elements to implement smooth continuous dosing of the amount of sand and increase the reliability of the process of transporting quartz sand particles to the contact zone of the wheels with the rails, taking into account the adhesion load.

Engineering solutions have been developed and experimentally confirmed for modernisation of sand supply systems of serial locomotives to implement smooth continuous regulation of the amount of sand flow from the sandbox nozzle body by installing a throttling device with a servo drive while

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increasing the performance and reliability of standard sandbox nozzles by replacing the needle-type adjusting screw with a screw, equipped with a set of jets with calibrated holes designed for different maximum sand flow rates.

Engineering calculations of a gas-air injector were made to increase the flow rate of the sand-air mixture to more than 40 m/s due to the injection of an additional volume of air with a reduced consumption of compressed air from the pneumatic supply line of locomotives compared to standard sand supply systems.

An improved sand supply system has been designed and developed based on the effect of vibration liquefaction of a layer of quartz sand particles to implement smooth continuous dosing of the amount of sand by changing the frequency, amplitude and magnitude of the disturbing impact on the layer of bulk material in the sandbox nozzle body, and the stability of operation under external vibration impact has also been experimentally confirmed that simulates the vibrations of a rail vehicle.

The proposed measures can be used in the design of new series of traction rolling stock, as well as in modernisation and overhaul of operating traction rolling stock of various types and purposes.

For the first time, a classification of sand supply systems for traction rolling stock has been proposed based on the analysis of designs and operating principles of sand supply systems for locomotives of various types and purposes.

The effective angle of inclination and layout of the bedding sleeve, as well as the flow rate of the sand-air mixture, were determined to implement the sand supply process with the greatest efficiency while reducing the loss of quartz sand particles during transportation to the wheel-rail adhesion zone when exposed to a side wind of up to 20 m/s. It has been established that the universal layout of the bedding sleeve and its inclination angles relative to the rail surface is a «combined» one at angles of 10+2°. This arrangement of sand pipes makes it possible to ensure a guaranteed delivery of quartz sand grains to the wheel-rail contact zone in a volume of at least 90 %, provided that the flow rate of the sand-air mixture from the outlet section is more than 40 m/s.

An engineering calculation of geometric and gas-dynamic parameters was carried out, on the basis of which a design of a gas-air injector was proposed to increase the flow rate of the sand-air mixture to more than 40 m/s due to the injection of an additional volume of air with a reduced consumption of compressed air from the pneumatic supply line of locomotives per one sandbox nozzle, compared to standard sand supply systems. Layout diagrams for the location of the injector for locomotive sand supply systems have been developed with the possibility of increasing the flow rate of the sand-air mixture and purging sand pipelines without implementing sand supply.

A stand has been developed, representing part of the standard sand supply system of a locomotive, on which a system for implementing smooth continuous regulation of the flow rate of sand from the sandbox nozzle body by installing a throttling device with a servo drive has been experimentally studied. Based on a three-dimensional computer model in real scale of the main elements of the sand supply system for the study of gas-dynamic processes in the sand supply system, including taking into account movement of sand grains, approximating dependencies were obtained that simplify the selection of the diameter of the adjusting screw nozzle hole, based on air flow velocities in characteristic sections air channels.

During field tests, it was established that on the surface of the rail, after sand is supplied under the wheels of the locomotive, two distinct fractions of particles are formed – a layer of densely packed particles on the central part of the rolling surface, which is a trace from the movement of the wheel along the rail in the size of the contact patch with a grain size of less than 0,1 mm, as well as uncompacted – corresponding to the particle size of the original sand from 0,1 to 0,5 mm, not yet involved in the friction process, located closer to the side faces of the rail head. Based on the results of laboratory studies, the percentage ratio of the concentration of sand particles on the surface of the rail

after the passage of the driving wheels of the locomotive was obtained, and it was also found that sand grains of these fractions had a positive effect on increasing the friction coefficient.

The range of recommended consumption of the amount of sand per linear meter of track has been determined depending on various factors to increase and stabilise the adhesion properties of traction rolling stock to prevent excessive slipping of the driving wheels with the rails in traction and braking modes.

A method for dosing the amount of sand under the wheels of a locomotive is proposed, based on the use of the effect of vibration liquefaction of a layer of quartz sand particles to implement smooth continuous dosing of the amount of sand by changing the frequency, amplitude and magnitude of the disturbing impact on the layer of bulk material in the sandbox nozzle body.

An improved sand supply system with the effect of vibration liquefaction of a layer of quartz sand particles for smooth continuous dosing of its quantity from the sandbox nozzle body by changing the frequency of vibration through the latex membrane by the pneumatic pulsator piston depending on the compressed air pressure has been developed and confirmed by a computational experiment based on three-dimensional solid-state modelling with finite volumes supplied to the pneumatic drive, with an increased flow rate of the sand-air mixture to ensure its stable flow from the outlet section of the bedding hose by ejecting an additional volume of air through a gas-air injector installed in front of the sandbox nozzle, with the possibility of purging the sand pipeline due to the provision of separate independent power supply to the pneumatic vibration drive of the nozzle and gas jet apparatus.

2.9.3. – Railway rolling stock, train traction and electrification
The work was performed and defended at Rostov State Transport University.

Smirnov, G. E. Methodology for substantiating test impacts when analysing the security of an informatisation object based on graphic-analytical methods. Abstract of Ph.D. (Eng) thesis [*Metodika obosnovaniya testovykh vozdeistvii pri analize zashchishchennosti obekta informatizatsii na osnove grafoanaliticheskikh metodov. Avtoref. dis… kand. tekh. nauk*]. St. Petersburg, PGUPS publ., 2023, 20 p.

A relevant scientific task is related to development of a model for analysing the security of an informatisation object and a methodology for justifying a set of test information technology impacts (ITI) to ensure rational completeness of coverage of vulnerabilities under restrictions on the cost of resources when analysing the security of an informatisation object.

The purpose of the dissertation research is to improve the indicators of the completeness of vulnerability coverage and the cost of testing through a reasonable choice of test information technology impacts when conducting an analysis of the security of an information technology object.

The object of the study is the processes and procedures for analysing the security and auditing of information security of an informatisation object, and the subject of the study is graphic-analytical methods used to justify a set of test ITI in the interests of analysing and ensuring the security of an informatisation object.

In the dissertation research, in order to improve the indicators of completeness of coverage of vulnerabilities and the cost of testing through a reasonable choice of test information and technical impacts when analysing the security of an information technology object, the scientific problem of developing a model for analysing the security of an information technology object and a methodology for justifying a set of test ITI to ensure rational completeness of coverage of vulnerabilities when restrictions on the cost of resources when analysing the security of an information technology object.

The result of solving a scientific problem is protected scientific results that have scientific novelty, theoretical

significance and are a contribution to development of the corresponding theoretical form of knowledge:

A model for analysing the security of information technology objects (IO) based on the use of test ITI, characterised by construction of a four-level graph linking with each other: individual test ITI; resource consumption for their implementation; verifiable vulnerabilities; tested elements and subsystems of the informatisation object; indicators of identified and potentially prevented damage, as well as justification and introduction of functional dependencies to determine the weights of inter-level edges of the graph;

A methodology for justifying a set of test ITI to ensure rational completeness of coverage of IO vulnerabilities under restrictions on the cost of resources, characterised by a 2-stage process of finding a rational set of test ITI.

The obtained solutions to particular scientific problems and their use in the applied field made it possible to formulate an applied result that has practical significance and is a contribution to development of technical and applied information security audit tools:

Scientifically based recommendations are given on the architecture of an automated complex for analysing the security of information resources using test ITI, based on the model and methodology first developed in this dissertation research and putting into practice the main provisions for formation of a rational set of test ITI in terms of completeness of coverage of vulnerabilities and the cost of testing.

The purpose of the dissertation work was achieved by solving the assigned problems. The presented model and methodology made it possible to improve the indicators of completeness of coverage of vulnerabilities and the cost of testing an informatisation object through a reasonable selection of test ITI and provide a 22 % better value of the completeness of coverage of IO vulnerabilities and 20–46 % less resource consumption (with equal completeness of coverage of IO vulnerabilities) than when assessing the security of IO in accordance with other testing strategies.

The model and methodology developed in the thesis, as well as scientifically based recommendations, can be used by organisations conducting justification and development of hardware and software systems for information security monitoring centres, SIEM systems, as well as scientific organisations conducting research in the field of information security, in particular in areas of auditing and monitoring the security of information resources.

Prospects for further development of the topic include additional research into a randomised strategy for selecting test ITI and the application of the Monte Carlo method in general to solve the problems of auditing IO; taking into account the connections of elements in IO, as well as their influence on the properties of information security on the effectiveness of test ITI and the formation of the final test set.

2.3.6 – Information security methods and systems, information security.

The work was performed and defended at Emperor Alexander I St. Petersburg State Transport University.

Vasiliev, D. V. Increasing the efficiency of terminal processing and organisation of container trains. Abstract of Ph.D. (Eng) thesis [*Povyshenie effektivnosti terminalnoi obrabotki i organizatsii konteinernykh poezdov. Avtoref. dis… kand. tekh. nauk***]. Samara, SamGUPS publ., 2023, 16 p.**

A current research issue is ensuring sustainability of transport and logistics activities in the context of macroeconomic transformation by improving technologies for terminal processing of containers and organising transportation of goods as part of container trains based on implementation of a customer-oriented approach, allowing rational use of existing infrastructure capabilities, ensuring work in new markets, as well as demand among existing and potential users of transport services.

The purpose of the study was to improve the efficiency of terminal handling and organisation of container trains.

The object of the study included railway container transportation. The subject of the study is the technology of operation of container terminals and organisational and technological requirements for container trains.

The analysis of scientific, methodological and practical experience in organising transportation of goods in containers by rail has been carried out: in the context of current restrictions associated with the ongoing macroeconomic transformation, the lack of throughput and processing capabilities of terminal and logistics infrastructure facilities and the shortage of investment resources, development and implementation of highly effective working methods is required using digitalisation and automation of technological processes, as well as new organisational and technological solutions related to transportation of goods as part of container trains, ensuring a reduction in delivery time, a working fleet of containers and specialised rolling stock.

Functional requirements for an automated control system for a container terminal are formulated, providing intelligent control of its technological zones, the ability to take into account the influence of stochastic processes on its operation and find optimal solutions taking into account adjustments to plans and ongoing work.

To determine the optimal order of performing a set of loading and unloading operations during terminal handling of containers, a mathematical model and a genetic algorithm have been developed to ensure acceleration of processing of containers and rolling stock at the terminal by reducing the idle run of the terminal and the number of redundant rearrangements of containers in cases where the target container is blocked by another container.

To increase the efficiency of cargo transportation as part of container trains for the carrier and to minimise unproductive material and time losses of clients, an economic and mathematical model has been developed that allows solving optimisation problems of choosing the length of container trains on a given railway route. The proposed economic and mathematical model describes the mechanism of interaction of transportation parameters, taking into account the possibility of the influence of the length of a container train on demand (volume of container traffic); reduction of cargo delivery time; changing the tariff value while reducing delivery time.

The length parameters of container trains for a specific direction of formation are determined based on the capacity of the direction, the number of locomotives used, the loading plan, availability of containers and platforms at the container terminal, availability of platforms, containers on the approach to the junction station, as well as taking into account the forecast demand for this transport a product based on reducing accumulation time, delivery time and regularity of transportation. An economic indicator – the carrier's profit – was chosen as an efficiency criterion.

A methodology has been developed for establishing organisational and technological requirements for assignment of container trains, which allows solving optimisation problems of choosing the lengths and frequency of running container trains on a given railway route. An algorithm for assigning a container train is proposed, which can be used to adjust the current Regulations for organising container trains, in terms of determining the economic feasibility of organising a container train by employees.

Quantitative dependences of the change in the specific profit from organising a container train on the variation of its length for various parameters of demand for transportation, tariff and delivery time were obtained, which confirm the hypothesis about the possibility of finding the economically optimal length of a container train outside the regulated interval from 57 to 71 conventional wagons for certain combinations transportation parameters.

The developed mathematical models and methods were tested.

To check the adequacy of the mathematical model and the genetic algorithm for optimising the operational planning of loading and unloading mechanisms, a program in the Java language was developed. Numerical experiments showed an average increase in the efficiency of handling containers and specialised rolling stock by 9,95 %. The greatest reduction in duration of loading and unloading operations can be achieved in the case of handling a public container train.

Taking into account the number of PRM owned by the Central Directorate for Management of the Terminal and Warehouse Complex, a branch of JSC Russian Railways, designed to work with large-capacity containers, the estimated annual economic effect from reducing PRM electricity consumption can amount to 65,2 million rubles/year.

Using the example of the direction of circulation of the container train St. Petersburg – Novorossiysk, economically feasible organisational and technological requirements for the purpose of container trains were determined. When sending a train with a length determined in accordance with the methodology, the train accumulation period is reduced by 2,8 days, demand increases by 8,26 %, and the economic effect will be 2,4 million rubles/year.

The proposed measures ensure a reduction in the working fleet of fitting platforms by 306 units and containers by 20563 units.

2.9.4 – Transportation processes management.
The work was performed and defended at Samara State Transport University. ●

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