Selected abstracts of D.Sc. and Ph.D. theses submitted at Russian transport universities

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Baronaite, R. A. Determining prospective need for track works in the short and medium term depending on the track operating conditions. Abstract of Ph.D. (Eng) thesis [*Opredelenie perspektivnoi potrebnosti v provedenii putevykh rabot na kratkosrochniy i srednesrochniy period v zavisimosti ot uslovii ekspluatatsii puti. Avtoref. dis…kand. tekh. nauk*]. Moscow, JSC VNIIZhT, 2024, 24 p.

The increasing complexity of operating conditions caused by the increase in the number of heavy trains in circulation, the use of high-power locomotives, the growth of train traffic density and subsequent intensification of processes of cumulation of track deteriorations, leads to the need to adjust the existing track maintenance system.

According to existing approaches, work on prompt elimination of emerging deteriorations is carried out based on the results of processing information on the actual track condition after passage of track measuring cars, and planning of alignment work for the medium term is based on the deadlines for assigning work differentiated by criteria and track classes. Planning of repair intervals on several sections of particularly busy lines is carried out mainly in accordance with the train schedule and available resources.

The objective of the thesis research is to develop a scientifically based system for organising and planning alignment work on sections with high cargo traffic density, based on a multi-variant forecast of changes in indicators characterising the track condition, and to clarify the procedure for assigning the frequency of monitoring the main parameters of the track gauge geometry under various operating conditions on the network.

The experimental component of the research included the results of a network experiment to determine the intensity of the growth of the amplitudes of individual irregularities on the railway network using an array of data obtained from the results of the passage of track measuring cars over a two-year period.

The reliability of results of the scientific research is determined by the results of statistical processing of an array of data on the condition of the track on sections with different operational characteristics with a length of more than 5 thousand km over a two-year observation period.

The results of scientific research on improving the system for organising and planning alignment work on sections with high cargo density, based on a multi-variant forecast of changes in indicators characterising the condition of the track, are summarised.

The patterns of accumulation of general track deteriorations at various stages of the life cycle under conditions of especially heavy-duty lines and the intensity of growth of the amplitudes of individual irregularities under various operating conditions on the network are revealed.

The main provisions of the method of two-component statistical assessment of stability of a track section by parameters simultaneously distributed along the length and in time (by tonnage) are presented.

The patterns of change in stability indicators of a track section by parameters distributed along the length and in time (passed tonnage) are established based on the developed method.

The influence of operating conditions and the system of organising technical maintenance on occurrence and development of general track deteriorations is proven.

Additional criteria for determining the need for prompt work are obtained and proposed based on the provisions of the theory of emissions within random processes considering the rate of increase in the amplitudes of individual irregularities.

A methodology for multi-variant forecasting of the track condition for the medium term is created depending on the scheme of organising technical maintenance on a specific section and at specific stage of the track life cycle.

Provisions on the need to forecast the condition of the track when determining the need for track maintenance work and proposals to clarify the criteria for assigning preventive track alignment on particularly busy lines have been introduced into the regulatory documentation.

The prospects for further development of the research topic are linked to determining options for using scheduled preventive alignment in the general system of track maintenance to extend the periods between repairs under various operating conditions.

2.9.2. – Railway track, survey and design of railways (technical sciences).

The work was performed at JSC Railway Research Institute of JSC Russian Railways (JSC «VNIIZhT»), defended at Russian University of Transport.

Dubinova, O. B. Fretting wear of vibration-loaded flange joints. Abstract of Ph.D. (Eng) thesis [*Fretting-iznashivaniie vibronagruzhennykh flantsevykh soedinenii. Avtoref. dis…kand.tekh.nauk*]. Moscow, National University of Oil and Gas «Gubkin University», 2024, 24 p.

A significant part of the equipment and structures of the gas transportation industry is operated using flange joints. Flange joints are widely used in complex gas treatment units, in the main transport system, at compressor stations (CS) and gas distribution stations (GDS). The increase in the volumes and speed of gas transportation in the last decade leads to an increase in the number of failures due to depressurisation of flange joints. According to statistics, the main reason for the loss of tightness in 40 % of cases is a high level of low-frequency vibration that occurs during transportation of the gas flow.

Increasing the reliability and safe operation of flange joints at gas complex facilities requires expanding the range of calculation methods that allow considering the negative impact of vibration on their individual elements and the entire joint. Thus, research aimed at increasing the service life of flange joints of pipeline manifold and gas transportation system equipment subject to fretting wear under vibration conditions are relevant and promising.

2.5.3. – Friction and wear in machines.

The work was carried out at National University of Oil and Gas «Gubkin University» and defended at Rostov State Transport University.

**Kurilkin, D. N. Increasing the energy efficiency of autonomous locomotives by improving the methods of operational traction calculations. Abstract of D.Sc (Eng) thesis [*Povysheni energoeffektivnosti avtonomnykh lokomotivov za schet sovershenstvovaniya*

***metoov opereativnykh tyagovykh raschetov. Avtoref. dis…dokt.tekhn.nauk*]. St.Petersburg, PGUPS publ., 2024, 32 p.**

The main problem solved in the thesis research was to increase the energy efficiency of autonomous locomotives by improving the methods of operational traction calculations based on the analysis of the current state of the power plant according to the data of on-board microprocessor control and diagnostic systems.

The objective of the study was to reduce fuel consumption for train traction and increase the accuracy of traction calculations by considering the actual state of the power plant of an autonomous locomotive when determining energy-optimal modes of train operation along a section.

As a result of the study of the current state of the issue of energy-optimal control of train traffic, it was found that, despite availability of information on the actual technical condition of the power plant of modern locomotives, this information is practically not used when performing variant and optimisation traction calculations, which reduces the accuracy of calculations and, as a consequence, the efficiency of rationing energy consumption for train traction and planning transportation work.

It has been established that the data recorded by microprocessor control and diagnostic systems of modern locomotives makes it possible to determine the components of the energy balance of the locomotive power circuit in various modes of its operation and to calculate the current traction characteristic corresponding to the current technical condition of the locomotive power plant.

A method has been developed and tested for determining the power consumption for the most significant auxiliary loads of the locomotive energy circuit, namely:

• for excitation of traction and auxiliary generators of diesel locomotives with various excitation unit circuits (2TE116U and TEP70BS);

• for driving electric and hydrostatic motor-fans of the diesel cooling device according to MSU-T (P, E, A) data;

• for driving the brake compressor;

• for recharging the battery.

A method for determining power losses in the elements of a diesel locomotive' power circuit has been developed and tested, circuit including traction generator, switcher, traction electric motor, traction gearbox, wheelset.

A method for determining the actual circuit resistance and load characteristics of the traction electric motor based on MSU-T(P, E, A) data has been developed and tested.

Algorithms and software for calculating the actual traction characteristics of a locomotive have been developed; the actual traction characteristics of 2TE116U diesel locomotive have been calculated. When testing the software, it was shown that using the actual traction characteristics of locomotives allows for a more than twofold reduction in the error in determining the speed curve and the running time per haul.

A method for accounting for transient processes in the locomotive power plant caused by a change in the position of the driver's controller has been developed during traction calculations. It has been established that transient processes do not affect fuel consumption while simultaneously reducing the average power and operation of the diesel generator set.

A method for multidimensional search for an energy-optimal train trajectory has been developed and tested, considering the actual characteristics of the train, predicted climatic conditions, and the actual state of the locomotive's energy circuit. It has been established that implementation of the energy-optimal trajectory of train movement, found using the proposed method, allows to reduce fuel consumption by 5–7 % compared to the control modes used by drivers in ordinary operation.

A method for determining the modes of stopping and adjusting braking and a technique for calculating the braking forces of a train during pneumatic and electropneumatic braking, considering the inertia of the brake circuit, have been developed and tested. An empirical dependence for determining the friction coefficient of the brake linings of disc brakes of a high-speed train has been proposed and substantiated.

The scientific and practical novelty of the proposed technical and software solutions is confirmed by patent for invention No. 2015108825/11, certificates of state registration of computer programs No. 2022616927, 2019663752, 2019666370, 2018613898.

2.9.3 – Rolling stock of railways, train traction and electrification.

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

C. Wang. Manufacturing technology and material properties of composite sleepers (for Chinese conditions). Abstract of Ph.D. (Eng) thesis [*Tekhnologiya izgotovleniya i svoistva materiala kompozitsionnykh shpal (dlya uslovii Kitaya). Avtoref. dis…kand.tekh. nauk*]. Moscow, RUT publ., 2024, 24 p.

The objective of the thesis research was to develop a manufacturing technology and determine the physical and technical properties of the material of composite sleepers intended for use in China.

The scientific novelty and the most significant results of the studies include establishing:

– the optimal content of nanoparticles (≈ 1 % by weight) in polyvinyl chloride, due to occurrence of two competing processes associated with ordering (due to the formation of crystallites) and loosening of the polymer structure;

– the influence of intrinsic stresses within the polymer composite on the nature of destruction and its behaviour under load with formation of block structures during destruction;

– the properties of the material of the composite sleeper, considering their operation in the system «roadbed – ballast prism – sleeper – rail – rolling stock»;

– a multi-level approach (from the atomic-molecular to the macro level which is sleeper design) to control of the most important properties of the composite sleeper material: the modulus of elasticity and the value of the linear thermal expansion coefficient.

Analysis of the work of domestic and foreign scientists has shown the prospects for introduction of composite (composite, polymer, plastic) sleepers in railway transport due to the use of various large-tonnage household waste, by-products of industry and agriculture for their production, and thanks to availability in a number of countries, in particular, in China, of a local raw material base in the form of fast-growing bamboo; at the same time, the use of composite under-rail bases helps to solve a number of environmental problems.

It has been established that one of the main obstacles to the widespread use of composite sleepers for railways is the high rate of linear thermal expansion of the polymer matrix.

Multi-level modification of polyvinyl chloride, the matrix polymer of the composite sleeper, was carried out at five structural levels: atomic-molecular (with polymers), nano- (with carbon nanotubes), micro- (with fine chalk and wood flour), meso- (with bamboo fibre) and macro-level (with bamboo rods), as a result of which the value of the rate of linear thermal expansion $\alpha_t \leq 25{,}3 \cdot 10^{-6}\,^0C^{-1}$, was achieved, which enables the possibility of their use in most provinces of China.

The most important physical and technical properties of the developed material of composite sleepers of optimal composition, determining their long-term operation in the railway track, have better indicators than the material of the industrially developed composition: the value of the rate of linear thermal expansion is 1,6 times lower, and water absorption is 7,8 times lower; in this case, to establish the latter dependence, a new method for determining ultra-low water absorption for high-density materials was used, based on establishing a change in the volume of a sample upon its contact with water using electron-correlation speckle interferometry.

Contactless measurement of the deformation field by laser interferometry made it possible to establish the block nature of the destruction of samples of the material of composite sleepers under load, and using laser interferometry according to the developed method for assessing natural stresses, to show that the plastic nature of destruction of samples of optimal composition is due to a decrease in the level of natural stresses in it; Russian Federation patents No. 2672192 and No. 2710953 were received for devices for determining sample deformations during loading using a contactless laser interferometry method.

Technological schemes have been developed for extrusion (Russian Federation patent No. 2738498) and injection (Russian Federation patent No. 2737711) manufacturing of not only composite sleepers for various types of railway tracks, but also of bridge and switch beams, and of developed (Russian Federation patent No. 2707435 and People's Republic of China patent No. 20862218.6) innovative design of a composite sleeper reinforced with bamboo rods with adjustable load-bearing capacity and a reduced (up to 11 % of the maximum permissible) value of the rate of linear thermal expansion. The life cycle assessment of the composite sleeper confirms the competitiveness of the proposed composite sleeper design relative to wooden sleepers in terms of environmental sustainability.

2.1.5. Construction materials and products.

The work was performed and defended at Russian University of Transport. ●

NEW BOOKS ON TRANSPORT AND TRANSPORTATION

The list of original titles in Russian is published in the first part of the issue

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Artyakov, V. V., Chursin, A. A., Ostrovskaya, A. A. Innovation Management. Methodological Tools: Textbook [*Upravlenie innovatsiyami. Metodologicheskiy instrumentariy: Uchebnik*]. 2nd ed., rev. and enl. Moscow, INFRA-M publ., 2024, 295 p. ISBN 978-5-16-019241-3 (print).

Belyakov, V. V., Vakhidov, U. Sh., Kolotilin, V. E. Engines of Special Transport and Technological Machines: Study guide [*Dvizhiteli spetsialnykh transportno-tekhnologicheskikh mashin: Ucheb. posobie*]. Nizhny Novgorod, Nizhny Novgorod State Technical University named after R. E. Alekseev, 2024, 259 p. ISBN 978-5-502-01785-5.

Bugakova, N. Yu., Gruntov, A. V., Zorchenko, N. K., Pelmenev, V. K. Didactic model of continuous professional and legal training of cadets in the educational process at a maritime university: Monograph [*Didakticheskaya model nepreryvnoi professionalno-pravovoi podgotovki kursantov v obrazovatelnom protsesse morskogo vuza: Monografiya*]. Kaliningrad, Publishing house of BGARF, 2024, 109 p. ISBN 978-5-7481-0552-1.

Chursin, A. A., Abueva, M. M.-S. Innovation Management: Textbook [*Upravlenie innovatsiyami: Uchebnik*]. Moscow, INFRA-M publ., 2024, 330 p. ISBN 978-5-16-017566-9 (print).

Degtyarev, V. S. English-Russian marine dictionary [*Anglo-russkiy morskoi slovar*]. Moscow, U Nikitskikh vorot publ., 2024, 1196 p. ISBN 978-5-00246-010-6.

Dorokhin, E. G. Fundamentals of Operation of Relay Protection and Automation: Study guide [*Osnovy ekspluatatsii releinoi zashchity i avtomatiki: Ucheb. posobie*]. Moscow, INFRA-M publ., 2024, 409 p. ISBN 978-5-16-019509-4.

Edimichev, D. A., Minkin, A. N., Klochkov, S. V. [*et al*.] Fire Safety of Electrical Installations: Study guide [*Pozharnaya bezopasnost elektroustanovok: Ucheb. posobie*]. Moscow, INFRA-M publ.; Krasnoyarsk, SFU publ., 2024, 195 p. ISBN 978-5-16-019590-2.

Ergashev, U. E., Suslov, O. A., Begmatov, N. I. Features of laying welded rails of a continuous track using hinged type technological equipment: Monograph [*Osobennosti ukladki svarnykh relsovykh pletei besstykovogo puti s primeneniem tekhnologicheskoi osnastki navesnogo tipa: Monografiya*]. Ufa, Aeterna publ., 2024, 131 p. ISBN 978-5-00177-958-2.

Grechanik, A. V., Zamukhovsky, A. V., Semenov, E. V. Design and calculation of the track gauge: Study-method. guide [*Proektirovanie i raschet relsovoi kolei: Uchebno-metod. posobie*]. Moscow, Pero publ., 2024, 58 p. ISBN 978-5-00244-215-7.

Grodsky, V. S. Three aspects of reconstruction of the economy: Monograph [*Tri aspekta rekonstruktsii ekonomiki: Monografiya*]. Moscow, RIOR: INFRA-M publ., 2024, 314 p. ISBN 978-5-369-01943-6.

Ivanov-Tolmachev, I. A., Sidrakov, A. A., Seredov, E. A., Kolmykov, V. S. Features of development of railway junctions: Study guide [*Osobennosti razvitiya zheleznodorozhnykh uzlov: Ucheb. posobie*]. Moscow, RUT (MIIT) publ., 2024, 134 p. ISBN 978-5-6051508-5-5.

Kazakova, N. A., Permitina, L. V. ESG-concept of production accounting and management of industrial organisation development sustainability: Monograph [*ESG-kontseptsiya proizvodstvennogo ucheta i upravlenie ustoichivostyu razvitiya promyshlennoi organizatsii: Monografiya*]. Moscow, INFRA-M publ., 2024, 250 p. ISBN 978-5-16-018717-4.

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Skubriy, E. V., Melnichuk, I. I., Zheltenkov, A. V., Pleshkov, M. L. Innovative mechanism for the development of industrial organisation management: Monograph [*Innovatsionniy mekhanizm razvitiya upravleniya promyshlennoi organizatsiei: Monografiya*]. Moscow, INFRA-M publ., 2024, 166 p. ISBN 978-5-16-019044-0.

Vorobyov, S. A. Operation of transport and technological machines and complexes: Study guide [*Ekspluatatsiya transportno-tekhnologicheskikh mashin i kompleksov: Ucheb. posobie*]. St.Petersburg, Naukoemkie tekhnologii, 2024, 193 p. ISBN 978-5-907804-25-8.

Compiled by Natalia Oleynik ●