

Section I

Shipbuilding, ship repair, and ecological safety of the ship

Borisov A.M., Prjanichnikov K.N.

The design of the hull construction reinforced concrete mooring pontoons

Keywords: mooring pontoon, floating object, Russian River Register rules, hull construction, reinforced concrete, reinforcement, General strength, local strength, bending moment, stresses, crack resistance

Annotation. The results of verification of compliance with the requirements of the Rules of the Russian River Register (RRRR) to the design and strength of the hulls of berthing pontoons of three types built by Marinetek: M3320BRS, M3315HDS, M2715HDS, made of reinforced concrete. Mooring pontoons rack type designed for mooring small boats with displacement of up to 200 tons, can be used as single berths or be interconnected for the formation of floating piers of different lengths and configuration. Conducted instrumental researches of berthing pontoons with the definition of the main dimensions, the thickness of the cladding, the scheme of reinforcement plates of the shell plating strength of concrete. The inner space of the pontoons is filled with polystyrene foam to ensure unsinkability. In accordance with the RRRR calculations of strength and crack resistance of the main body bonds of the three types of mooring pontoons. The results of comparing the requirements of RRRR to the structural elements of the hull mooring pontoons adopted in the project. It is shown that the requirements of the RRRR on the hull structure, strength and crack resistance of mooring pontoons of projects M3320BRS, M3315HDS and M2715HDS for classification and assignment of the class of floating objects "P 1,2 IV" of the Russian River Register are fulfilled.

Bychkov V.Y., Grosheva L.S., Plyushchaev V.I.

The field of applicability of the algorithm keep the vessel with wheeled propulsion-steering complex on the course

Keywords: vessel, wheel propulsion and steering complex, the algorithm of keeping the vessel on the course, quality indicators of the control system.

In Russia, ships with a wheeled propulsion-steering complex are being built, which do not have a traditional steering wheel. Control of the vessel is carried out by changing the ratio of the frequency of rotation wheels located on the sides in the aft of the vessel. The article discusses the applicability of the algorithm to keep the ship on course, implementing simultaneous control of two propeller wheels, taking into account external influences.

Vas'kin S.V., Leushova I.E.

Selection of type and capacity of ship plants for treatment of waste and oily water tanker-bunker-environmental vessel, operated on Lake Baikal

Key words: lake Baikal, collecting of waste from vessels, tanker-bunker-ecological vessel, the content of harmful substances when discharging effluents into water bodies, the norms of accumulation of waste and oily water, the quality of wastewater treatment, ship plants for the treatment of waste and oily water, the capacity of receiving tanks for waste and oily water, the specific characteristics of equipment for the treatment of waste and oily water.

Annotation. This article addresses the issue of preventing pollution of Lake Baikal by ship waste and oily waters. For this purpose, the quantity and composition of these waters on the ships of PJSC «ESINC» is determined. To ensure the environmental safety of vessels, it is proposed to use the vessel collecting wastewater and oily water from vessels equipped with water treatment equipment. As a result of processing the data for the vessels serviced by the collector, the productivity of installations for the treatment of waste and oily water of the collector, as well as the capacity of its tanks for receiving these wastes, are calculated. Based on the analysis of the characteristics of the ship's environmental equipment, recommendations are given on the choice of specific types of systems for the treatment of waste and oily water.

Glebov V.V., Blinov V.M., Repin F.F.

Effect of hot plastic deformation and heat treatment on the process of formation of chromium nitride in steel 05H22AG14N7M

Keywords: chromium nitrides, discontinuous decomposition, high-nitrogen steels, mechanical properties, intergranular corrosion.

The effect of heat treatment and hot plastic deformation on the formation of chromium nitrides in steel 05H22AG14N7M was investigated.

Kalinina N.V., Soldatkin O.B.

Theoretical and experimental studies of the influence of the ice cover state on the ice propulsion of ships

Keywords: full-scale tests of icebreaker, measuring complex, friction coefficient of a ship hull on ice, the state of the ice cover, ice propulsion, the curve of icebreaking capability.

Annotation. The results of full-scale tests on the icebreaker «Captain Zarubin» by definition, the coefficient of friction of the ship hull on the ice cover for various exploitation conditions on the Volga River are presented. Описана методика проведения эксперимента и измерительный комплекс. The method of the experiment and the measuring complex are described. The calculations of ice propulsion for the icebreaker (project 1105) were made using the obtained experimental data on the existing semi-empirical models during continuous movement and by ramming. The article shows that the state of the ice cover strongly influences on the ice resistance of ships at continuous movement and slightly at movement by ramming. It leads to increase ice resistance of icebreakers.

The results of experimental studies can be used to predict the ice propulsion existing and projected ships.

Naumov V.S., Kochneva I.B., Dyomina E.A.

Aspects of the implementation of the national project «ecology» in the field of ship recycling

Keywords: ship recycling, ecological safety, ship recycling facility, national project «Ecology»

Adopted on behalf of the President of the Russian Federation in 2018, the national project «Ecology», including among the eleven Federal projects, as the project «Improvement of the Volga», started to be implemented in the Nizhny Novgorod region. This article analyzes the necessary amount of scientific, technological and organizational work required to improve the environmental situation by reducing the negative impact of wrecks and the successful implementation of the tasks set by the Government of the Russian Federation. According to the authors, the plan of measures for the lifting and disposal of sunken ships should be divided into four stages, including both the direct lifting of ships and their subsequent disposal, and related works aimed at creating the necessary and high-quality infrastructure, scientific justification of the work with the least environmental damage.

Rodkina A.V.

Corrosion protection as structure of a ship mass load

Keywords: mass load, corrosion protection, ship.

The requirements of the Rules and Norms of classification societies are based on the assumption that measures to protect the hull against corrosion in accordance with the standards and other regulations are taken during the construction and operation of ships. Components of the load have been obtained for various types of corrosion protection for the purpose of ship hulls designing. The analysis of mass load changes for the various types of ships hull structure corrosion protection, depending on the displacement. A mass load comparison the various types of ships hull structure protection against corrosion was made; data was generated on the dependence of the corrosion protection load mass on the ship displacement, which makes it possible to choose the smallest type of corrosion protection. The importance of the various types of corrosion protection mass load estimating at the initial stages of design is determined. The practical significance of the work lies in the fact that the obtained results can be used at the design stage to select a smaller weight for ship corrosion protecting.

Gramuzov E.M., Rodkina A.V., Ivanova O.A.

Analysis of technical and economic indicators of ships hull construction corrosion protection

Keywords: ship, corrosion protection, cost, capital costs, operating costs.

The article analyzes the technical and economic indicators of the ship hulls corrosion protection. The direction of the investigation was chosen due to the fact that the corrosion-mechanical destruction of ships and floating technical structures leads to large economic losses. The solution to the problem of corrosion is among the most pressing problems in the development of the Russian economy. To achieve the goal of the article, a cumulative simplified calculation of the economic feasibility of choosing the type of corrosion protection for ship hull structures was used. The calculation of the ship hulls corrosion protection cost has done, data on the dependence of capital investments and operating costs in the system of corrosion protection on the ship displacement were formed. It was determined that for vessels with a displacement of more than 6000 tons in the case of applying cathodic protection by impressed current against corrosion instead of cathodic protection by sacrificial anodes, the total cost of protection against corrosion-mechanical damage is reduced. The results of the study can be used by shipbuilders at the ships design stage, which allows the correct choice of the corrosion protection type and reduces its total cost.

Ronnov E.P., Korepanov A.E.

Trimarans: state and prospects of development

Key words: trimaran, outriggers, multihull vessels, high-speed passenger trimarans, elongation relative, favorable interference of the wave system.

Annotation. The paper reflects the history, the status of development and current trends in the design of trimaran vessels. It is shown how the terminology on vessels of this type was formed, the information about the main elements and characteristics of modern cruising, passenger and military vessels-trimarans. On the basis of the analysis of data on the constructed trimarans, general conclusions are made. Advantages and disadvantages of these vessels are noted, promising directions of research on their design are determined, namely, at what length, width, displacement it is rational from the point of view of the speed regime to use this or that scheme of the location of outriggers along the length and width of the vessel in order to achieve a favorable wave interference of the main body and outriggers.

Ronnov E.P., Kochnev Y.A.

Features ensure the performance of the ship's anchor

Keywords: anchor increased holding power, operating load, the deformation of the legs of the armature

When designing a new type of ship anchor, it is necessary to take into account the requirements of the Rules of classification societies for its design, material, as well as the strength of various elements. However, in the actual operation of the anchor, loads that are not currently taken into account by normative documents and due to the peculiarities of the behavior of the anchor in the ground, when lifting and entering the anchor cleave and niche are possible. In the article, on the example of the balance anchor of increased holding force, the calculations of the strength of the paw are given, both under the action of the load regulated by the Rules and the limit load that can arise during the operation of the anchor. analyzed the different ways of contact of the armature with the environment. It is shown that the real dangerous load for the paw is less than the trial load during the tests, and as a consequence, it is required to take it into account in the design.

Smirnova M.V., Kapustin I.A., Glukhova V.S., Nosova A.D.

Experimental study of mean and pulsation velocities of flows formed by pop-up bubble flow in a near-surface water layer in the presence of a surfactant film

Keywords: laboratory experiment, visualization of the flow, surfactant film, bubble flow, PIV, tracer, mean velocity, pulsation velocity, slick

Annotation. One of the topical problems of gas pipeline transport today is the detection of gas leaks in underwater sections of gas pipelines and reducing their negative impact on the environment. This paper is devoted to the development of methods for remote detection of gas leaks from underwater gas pipelines by specific slick signatures. The technique of laboratory modeling and visualization of the flows formed in the surface layer of water by pop-up bubble flow has been worked out. Using the Particle Image Velocity (PIV) method, the influence of surfactant films on the mean and pulsation flow velocities in the near-surface water layer were studied. The mean velocity field and pulsation velocity field in the laboratory cuvette

in the absence and in the presence of surfactant film were obtained. It is shown that the presence of surfactant film has a significant effect on the flow pattern in the near-surface water layer.

Fevralskikh A.V.

Numerical investigation of board seal aerodynamics impact on wing in ground effect vehicle characteristics

Keywords: *wing in ground effect vehicle, air cushion, conceptual design, aerodynamics, numerical simulation, ANSYS CFD*

Annotation. *One of the advantages of wing in ground (WIG) effect vehicles is considered with the possibility of a high value of transport efficiency on cruise motion mode than it is possible for air-cushion vehicles (ACV). It is achieved due to low WIG vehicles drag-to-displacement ratio values. The WIG vehicles with the static air-cushion (AC) supported by fans need the low power of engine on a start motion mode, than the classic WIG vehicles with the power augmentation on takeoff. But the construction elements of the take-off systems can have impact on the fluid near wing on ground effect cruise motion mode, that leads to decrease the lift force impact on WIG vehicle. The results of calculations show that the known operated WIG vehicles with the static air-cushion as chassis have the low values of transport efficiency, than the ACV with the ballonnet seal. The insufficient project development of the WIG vehicles with AC as chassis can be considered with the lack of data about the impact of board seal on the wing aerodynamic streamlines. Using computational fluid dynamics methods the ground effect aerodynamics of the both WIG layouts with ballonnets and with plane endplates is investigated. The lift coefficient, the drag coefficient and the lift-to-drag ratio are obtained by results of the numerical investigation. As it shows, the ballonnet board seal promotes the development of board directed flow near wing and decrease the lift-to-drag ratio. For some values of pitch angle the reverse ground effect (the lift force decreasing for ground clearance decreasing) is observed. For WIG with the ballonnet air-cushion design it is recommended to use the ballonnets with redans.*

Cheban Y.Y., Lukina E.A., Olga V.M., Kshtaltnaya M.N.

Numerical simulation of the towing tests extra-capacity catamaran

Key words: *Computer fluid dynamics, extra-capacity catamaran, towing test, NUMECA FINE/Marine, inland waterways, resistance, wave surface, wave height, interference phenomenon*

Abstract. *A numerical estimation of the full resistance for a new internal waterways type vessel is given. Creation of a new type of vessels is requires to ensure a combination of high deck area per tonne of cargo capacity and high speed of a river vessel. The value of Froude numbers for large river catamarans corresponds to an interference minimum of the residual drag curve in deep water, which provides a certain reduction in drag and towrope power. The catamaran full resistance curve in the range of subcritical rates in deep water by CFD code NUMECA/FineMarine. Analysis of the wave fields around catamaran is given.*

Section II

Financial and accounting-analytical problems of the modern economy

Solovyeva V.G.

System approach to the implementation of innovative management technologies

Keywords: *management, innovation, innovation management, integrated management system, quality management system, standardization, requirement compliance.*

Perceptively, the expanding of the enterprise competitive advantages on the basis of ensuring the efficiency and effectiveness of its processes, an innovative approach to management may involve the integration of various management systems that take into account various aspects of activity. This makes it extremely important to choose the basis for the integration of the relevant subsystems and, thus, is of fundamental importance within the framework of the implementation strategy of the integrated management system. This management improvement tool can also be used at the enterprises of the water transport industry. Their activities are strictly regulated by the requirements of international and national regulatory acts in various fields, for example, in the field of environmental management or safety management. At the same time, the result

of the improvement on the basis of the integrated management system introduction is the increase in the efficiency of the organization's management activities.

Section III

Economics, logistics and transport management

Kegenbekov Z.K., Kerimkulova D.A.

Analysis of the current state of the railway network of Kazakhstan

Key words: Railways, railway transport, international railway corridors, railway network of Kazakhstan, railway network configuration.

Abstract. The article is devoted to the analysis of the stages of formation of the modern railway network of Kazakhstan, as well as its current state, configuration and position relative to international corridors. Theoretical and methodological basis of the work was made by the works of Kazakhstan and foreign experts in the field of transport and economy, devoted to the issues of railway transport and railway infrastructure of Kazakhstan, as well as its inclusion in international transport corridors. Statistical, cartographic and reference materials of the Committee on statistics of the Ministry of national economy of the Republic of Kazakhstan, annual reports of JSC «NC «KTZ», state programs of transport development, messages of the President of the Republic of Kazakhstan were used in this work. Scientific and theoretical provisions and conclusions formulated in the article can be the basis for solving practical problems in determining the future directions of development of the railway network of the Republic of Kazakhstan. Proposals for the straightening of railway routes can be used in further research.

Sergeev S.N., Urtmintsev Y.N., Zheleznov S.V., Malishkin A.G.

Conceptual model of evaluating the vitality of development of water transport systems on waterways of local value

Keywords: system analysis, conceptual modeling, transport system, local waterways, shipping, water transport infrastructure, the redistribution of cargo traffic, public efficiency.

Annotation. In recent decades, the use of small rivers for navigation has deteriorated sharply in Russia. Most regional traffic flows have shifted to road transport, resulting in a significant increase in the burden on the land transport network and the environment. The article deals with the problem of development of waterways of local importance (small rivers) and switching to them part of the traffic from road transport. The influence of the organization of river transport on the transport system of the region as a whole and the external environment is studied. A methodological approach for a comprehensive assessment of the socio-economic, social and environmental impact of the development of the regional water transport subsystem is developed. The use of this approach makes it possible to assess the feasibility of resuming navigation on small rivers and to determine the rational parameters of the fleet and waterway.

Section IV

Operation of water transport, navigation and safety of navigation

Bazhankin Y.V.

Using of navigational plotting simulator for training process

Keywords: simulator, quality of training, accuracy of ship position fix, navigational plot.

Annotation. Nowadays simulators are widely used in maritime industry for STCW courses training. However, simulators may be used for particular skills training. This article describes experience of using of navigational plot simulator to evaluate efficiency of using this kind of simulator. Fixing by two beacons and dead reckoning with set and drift were taken as standard task for trainees. Conditions of task as well as results are shown in the article. The analysis of obtained results is

done. Review of NS-3000 navigational plotting simulator is presented. The conclusion about advantages of using navigational plotting simulator over traditional methods of teaching Navigation is made.

Kazakov N.N.

Tool modeling of the condition of the water transportation system of the Republic of Belarus in the conditions of its innovative development

Keywords: *water transport system, methodology, modeling tools, innovative development, simulation model, modular basis, algorithm, key performance indicators, modeling labor intensity.*

Annotation. *The article contains the rationale for choosing a methodology that is purposeful and advisable to use when modeling the state of a regional water transport system in terms of its innovative development. It also highlights the relevance of the research for the conditions of the Republic of Belarus and its sub-sector of water transport is also documented. In addition, the characteristic of the principle of updating the methodology of providing innovative procedures of the sub-sector is provided and an algorithm for their implementation is proposed. Moreover, the substantiation of the choice of the method for modeling the states of the vector of development of the water transport system for the conditions of the Republic of Belarus is carried out and the parameters of the simulation are characterized. Furthermore, the principles of the formation of a simulation model of a water transport system are given and an algorithm for modeling its state in the medium term is proposed. The problem of optimizing the complexity of simulation modeling while ensuring sufficient detail of the model and an acceptable accuracy of the survey is also supported and indicated. Finally, suggestions for improving the toolkit in the direction of using the capabilities of artificial neural networks are given.*

Platov A.Y., Vasileva O.Y.

Analysis of the applicability of methods of calculating of the residual resistance coefficients of Inland ships for feasibility study of new ships

Keywords: *inland ships, water resistance, feasibility study, the methods of calculating the resistance, the type ships method, residual resistance coefficient, brake power of main engine.*

Annotation. *The article is devoted to the analysis of methods for calculating of the residual resistance coefficient for inland ships for feasibility study of ship design. It is shown that the existing methods have a significant error in comparing with model tests. It is noted that the forecast estimate of the error and its sign is impossible when it use direct methods of calculation. Signed «non-physical» behavior of some methods. It is made the assumptions about the reasons for this behavior. Based on the analysis, it is concluded that the currently existing direct methods for calculating residual resistance for feasibility study of ship design are generally not applicable.*

Tokarev Pavel N.

Estimation of safety maneuvering conditions of the vessel in wind at low speeds

Keywords: *ship, a limited area, wind, thruster, propellers «vrazdray» possible to hold the vessel «in place», straight-line motion, calculated.*

The paper presents studies of safe conditions for maneuvering ships in the wind on a limited size of the water area. The calculated dependences on the definition of permissible wind speeds at which it is possible to hold the vessel «in place». The angles of wind drift and the angles of the steering body shift in rectilinear motion using the bow thruster and the mode of operation «vrazdray», as well as the maneuver of the ship's lapel from the path line in the wind are obtained

Timoshek E.S., Malikova T.E.

Routing model for supply ships operating in the Arctic Region transport network

Keywords: *sea transport, logistics, modeling, fleet management, trump shipping, digitalization.*

Annotation. *This article considers some of the modern approaches to solving the problem of optimal fleet routing. Based on the analysis of the studies of various authors, it is concluded that the class of vessels routed is being developed and im-*

proved in the direction of adapting them to various working conditions of maritime transport, and the implementation of mathematical models is carried out with the use of linear programming methods available in MATLAB environment. The result of the study is an optimization model intended to provide the best control of the operation of supply vessels in the Arctic region. As the target for determining supply vessels routing, a transport network segment including three ports was chosen: the port of departure, the intermediate port (where the way cargoes are unloaded and loaded), and the port of destination. Compound operational costs of the vessel during the navigation period were taken as the optimality criterion. The practical application of the proposed model makes it possible to provide the best management of coastal traffic in the sea transport infrastructure, to assess the effectiveness of the use of a vessel in a particular node of the transport network.

Section V

Operation of ship power equipment

Burmakin O.A., Malyshev Y.S., Popov S.V., Shilov M.P.

Comparative analysis of results of research of the real ship power station and its models in transition operating modes

Keywords: ship power station, synchronization, parallel work, transition processes.

The article presents the results of simulation of transients of the ship power station and oscillograms of transients of a real ship power station. The comparison of transients for different operating modes of the power plant is given: synchronization, step switching of load on parallel generators, distribution and transfer of load to one of the parallel generators. The conclusions about the conformity of the quality of transients and the magnitude of the error of the simulation results associated with the imperfection of the model are made. Ways to improve the model by introducing the synchronization process in automatic mode, as well as upgrading the power plant control system by introducing synchronization modules and load balancing, are proposed.

Matveev Y.I., Orekhvo V.A., Khramov M.Y., Orekhvo A.V.

Peculiarities of the forming of facing shaft faces

Key words: propeller shaft, cladding, fretting corrosion, polymeric materials, tight fit, mechanical wear, fault detection, repair.

Annotation. This article discusses the possibility of using facing necks of propeller shafts using polymeric materials. To date, known technology using landing with a tightness or polymer adhesive materials used separately from each other. A fundamentally new method is proposed that combines two planting techniques for facing, due to the alternation of areas of landing with tension and polymeric adhesive materials along the length of facing. This development will significantly reduce the moment of shaft twisting relative to the cladding and thereby reduce the risk of fretting corrosion. The use of technology is possible both during repair work on an already operated fleet, and at shipyards in the construction of new ships.

Orekhvo V.A., Luzgin A.S.

Prospects for application of secondary converters heats of sea for producing electric power in ships of the river and navy

Keywords: heat conversion, electricity, electric generator, TAG, principles of heat conversion, heat recovery, devices for heat conversion, Peltier module.

Annotation. This article discusses the possibilities of recycling of secondary heat in the ship's conditions using the considered devices for generating electricity. The generation of electricity from thermal energy is a promising and affordable way to directly convert energy from one type to another. The relevance of the work presented is that the direct conversion of thermal energy into electrical energy without intermediate conversion into mechanical energy is the optimal solution to this problem. In this regard, the issue of converting heat into electricity is becoming more interesting and relevant. The most studied and promising way to convert secondary heat in the ship's conditions is the Peltier module.