Proposals for cooperation of *Foundry Department* of NTU “KhPI”

Foundry Department

Head of the department since 1997 and is currently a doctor of technical Sciences, professor ***Oleg Akimov***, olak@kpi.kharkov.ua

Producing specialty:

– Knowledge area – 13 *– "Mechanical Engineering"*
Occupation – 131 *"Applied Mechanics"*
– Knowledge area – 15 *"Automatization and Instrumentation"*
Occupation – 151 *"Automatization and computer-integrated technologies"*

Research areas:

– Computer-integrated design of cast parts. ***D.Sc., Prof. O. Akimov***.
– Improving the reliability of complex systems, optimization of technological solutions in terms of design, operation and reconstruction of workshops and development on their basis of new technical solutions in the field of technology and equipment, and technology creation and development of new binders for molds and cores for cold-technology. ***D.Sc., Prof. O. Ponomarenko.***
– Mathematical modeling of processes and optimization of mechatronic systems. ***D.Sc., Prof. D. Demin***.
– The hardening of parts made of alloys by innovative methods of chemical-thermal and combined processing. ***Ph.D. Associate Prof. K. Kostyk***.

Top publications in Scopus

AFI Idan, O Akimov, L Golovko, O Goncharuk, K Kostyk (2016) The study of the influence of laser hardening conditions on the change in properties of steels. Eastern-European Journal of Enterprise Technologies 2 (5 (80)), 69-73. DOI: 10.15587/1729-4061.2016.65455

WAR Dhafer, V Kostyk, K Kostyk, A Glotka, M Chechel (2016) The choice of the optimal temperature and time parameters of gas nitriding of steel. Eastern-European Journal of Enterprise Technologies 3 (5 (81)), 44-50. DOI: 10.15587/1729-4061.2016.69809

MK Mohanad, V Kostyk, D Domin, K Kostyk (2016) Modeling of the case depth and surface hardness of steel during ion nitriding. Eastern-European Journal of Enterprise Technologies 2 (5 (80)), 45-49. DOI: 10.15587/1729-4061.2016.65454

Akimov, O., Noori, S.M. (2015) The effect of heat treatment on the properties of the new iron-base alloy. Eastern-European Journal of Enterprise Technologies 6 (11 (78)), 35-40. DOI: 10.15587/1729-4061.2015.56370

**Akimov, O., Alekhin, V., Penzev, P., Dyachenko, A., Ovcharenko, A. (2015) Analysis of technological factors that significantly affect the formation of stresses in the cast machine parts
Eastern-European Journal of Enterprise Technologies 6 (7 (78)), 43-47. DOI: 10.15587/1729-4061.2015.56199**

O Akimov, O Koval, A. Pulyaev, E Dymko, T Egorenko (2015) Quality improvement of cast parts of ice: accounting technological aspects of the automated foundry. Eastern-European Journal of Enterprise Technologies 6 (1 (78)), 56-62DOI: 10.15587/1729-4061.2015.56039

K Kostyk (2015) Development of the high-speed boriding technology of alloy steel. Eastern-European Journal of Enterprise Technologies 6 (11 (78)), 8-15. DOI: 10.15587/1729-4061.2015.55015

**OV Seraya, DA Demin (2012) Linear Regression Analysis of a Small Sample of Fuzzy Input Data.
Journal of Automation and Information Sciences 44 (7), 34-48. DOI: 10.1615/JAutomatInfScien.v44.i7.40**

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Ponomarenko, O.I., Shinskij, I.O., Morgun, N.N. (2004) Lost foam casting of bronze alloys. Litejnoe Proizvodstvo

Demin, D.A., Pelikh, V.F., Ponomarenko, O.I. (1998) Complex alloying of grey cast iron. Litejnoe Proizvodstvo

Ponomarenko, O.I. (1998) Structural optimization of moulding and sand preparation systems. Litejnoe Proizvodstvo

Ponomarenko, O.I. (1997) Methods of improvement of operational efficiency of technological foundry systems. Litejnoe Proizvodstvo

Ponomarenko, O.I. (1997) Use of probabilistic automata for analyzing the operation of foundries. Litejnoe Proizvodstvo

Ponomarenko, O.I., Pelikh, V.F. (1997) Calculation of an optimum number of melting furnaces. Litejnoe Proizvodstvo

Demin, D.A., Pelikh, V.F., Ponomarenko, O.I. (1995) Optimization of the method of adjustment of chemical composition of flake graphite iron. Litejnoe Proizvodstvo

Akimov, O.V., Litvinenko, M.N., Pelykh, S.G. (1995) Computer networks for casting quality control. Litejnoe Proizvodstvo

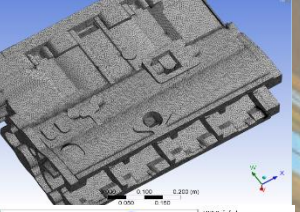
Akimov, O.V., Tkachenko, G.V., Rebik, A.A., Pelykh, S.G. (1991) Simulation of carrying capacity of castings. Litejnoe Proizvodstvo

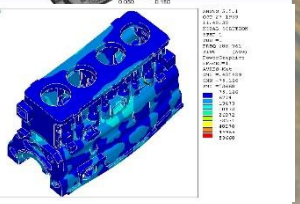
Pelykh, S.G., Litvenenko, M.N., Akimov, O.V., Tkachenko, G.V., Tushchenko, V.V. (1991) Computer-aided system for controlling casting quality. Litejnoe Proizvodstvo

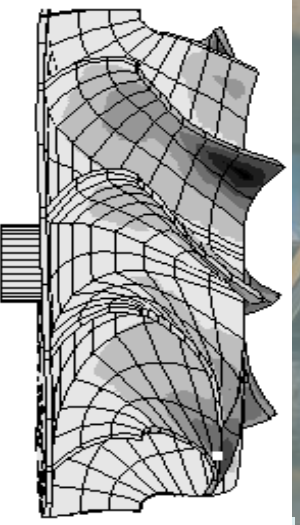
Ponomarenko, O.I., Tishchenko, V.V., Litvinenko, M.N. (1991)Use of computers for working out foundry equipment repair schedule. Litejnoe Proizvodstvo

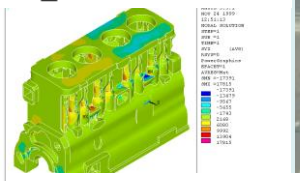
Computer-integrated design of cast parts

D.Sc., Prof. O. Akimov ID http://orcid.org/0000-0001-7583-9976



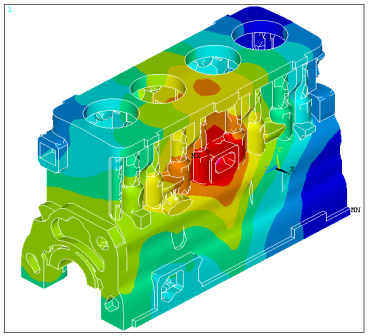


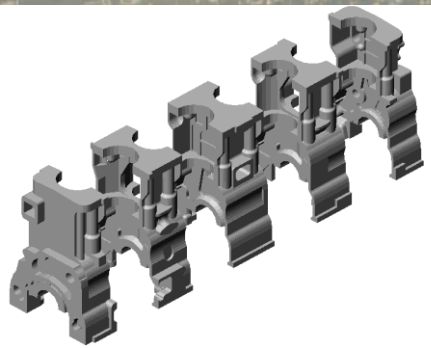


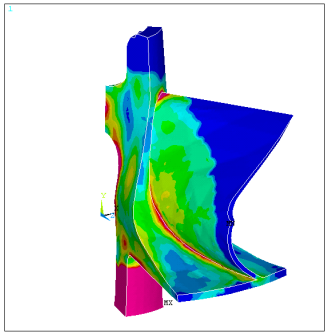


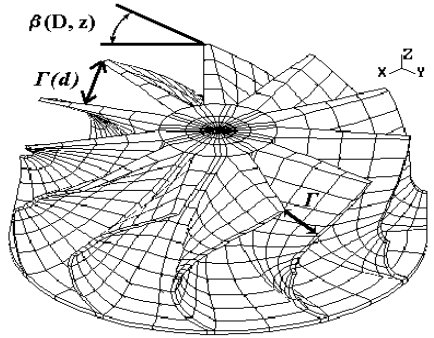
Research area is devoted to development of scientific bases design-engineering planning of the casting details of engines on the base of the use of modern experimental methods, computer-integrated tools and methods of the resource planning for creation of the casting details, which provides the set operating descriptions, resource, decline of prime price, time of planning and start, in a production, increase of competitiveness and reliability of engines of internal combustion.

Measures are developed on modernization of constructions of the casting details of engines taking into account 3th the measured distributing of remaining casting tension, heterogeneity of mechanical properties of alloy, in the different crossings of founding, universal methods of lead through of construction calculations of block-crankcase of cylinders of engines taking into account the dynamic, static, assembling loadings and directions of remaining casting tension.









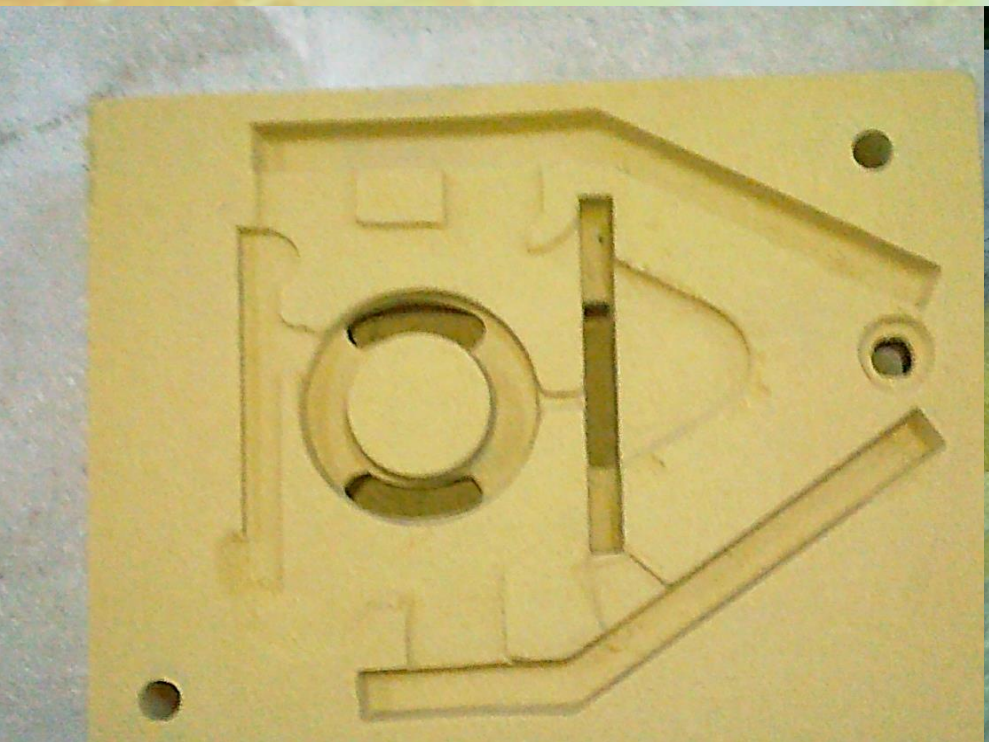
Improving the reliability of complex systems, optimization of technological solutions in terms of design, operation and reconstruction of workshops and development on their basis of new technical solutions in the field of technology and equipment, and technology creation and development of new binders for molds and cores for cold-technology

D.Sc., Prof. O. Ponomarenko

Regulation of the strength of molds and cores in the stages of their industrial use by establishing patterns of influence on the properties of additive mixtures, that improve the strength of molds and cores during cooking and contribute to softening of the mixture after pouring the metal and cooling, as well as the implementation of the technological process, which improves the quality of castings from carbon and non-ferrous alloys is an actual problem foundry production. It was developed and proposed a new universal supplement based on raw materials of vegetable origin - furfuryloxypropylcyclocarbonate (FOPCC) for cold-mixtures on liquid glass, which increases the strength of the molds and cores during their preparation and facilitates softening mixture after casting metal and cooling. FOPCC is an environmentally safe material, as by pouring metal into the mold as a result of the thermochemical degradation it decomposes and releases the composition in the amount of generated carbon dioxide and water vapor in the environment (Patent UA 95138 Ukraine). The main properties were cold-liquid mixtures using glass FOPCC which depend on the quality of castings with sand casting.

***SCIENTIFIC NOVELTY*: 1. For the first time the regularities of the effect of the number of universal supplements of furfuryloxypropylcyclocarbonate (FOPCC) in a mixture of quartz sand with liquid glass, foundry molds and cores on their properties (strength, vitality, attorney, permeability, fall). This allowed, while maintaining the level of its main physical-mechanical and technological properties to reduce its residual strength, reduce the complexity of manufacturing castings made of carbon and non-ferrous alloys and to improve their quality. 2. First the optimal composition of cold compositions on the basis of chromite sand with liquid glass with the universal additive of furfuryloxypropylcyclocarbonate for facing and core mixtures. The difference in development consists in the selection of additives for cold-mixes for chromite sand with liquid glass. It gives the chance, based on the values of the compressive strength, bending and tearing that occurs during the manufacture of the rods, and adjust the quality.**

THE PRACTICAL SIGNIFICANCE: **1. Created a new universal additive for cold-mixes with liquid glass – furfuryloxypropylcyclocarbonate, which can improve the strength of molds and cores during cooking and contributes to softening of the mixture after pouring the metal and cooling. Universal additive FOPCC is an environmentally friendly material, as in pouring metal into a form resulting in thermal degradation of FOPCC decomposes and allocates the amount formed of the composition of carbon dioxide into the environment (Patent of Ukraine UA 95138). 2. Was developed the process of preparation of core and mold cold-mixes with liquid glass with the universal additive, FOPCC using as fillers of quartz and chromite Sands, the proposed nomograms for the operational management of their properties and obtain high-quality castings of iron-and nonferrous alloys. 3. The compositions of cold-mixes on the basis of universal supplements, FOPCC were tested and introduced in industrial conditions at "Sumy scientific-production Association. M. V. Frunze" (Sumy), which showed its high efficiency. Improved surface quality of castings and their residual strength, to reduce the cycle of manufacture of cores compared to the adopted technological process on liquid glass with carbon dioxide, reduced the cost of cleaning the casting, the marriage of gas porosity of 80% (implementation Act from 09.11.2012).**



Mathematical modeling of processes and optimization of mechatronic systems

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A technology of artificial orthogonalization was developed. It allows estimating the parameters of the mathematical models that describe the electrosmelting, under circumstances where input variables are ambiguous, and data retrieval for models construction is small. The electrosmelting processes were simulated, applying the mathematical models "structure * property" based on the artificial orthogonalization in the operation of the control system of the electrosmelting. A structure of a functional was developed. The functional defines efficiency of the control of an electric furnace, which is a part of the casting conveyor, which could be used to develop the electrosmelting optimal control algorithm. A procedure for estimating the parameters of kinetic equations was developed. These equations describe the dynamics of the chemical composition of the alloy in real time, which could be used to determine the structure and parameters of the mathematical models that describe the state of the system during the thermo temporary melt processing for further search of the optimal control of the electrosmelting. The algorithm of the optimal control of the electrosmelting during the thermo temporary processing was suggested. This processing allows implementing the speed control, getting optimal transients in the controlled system in terms of speed, and ensuring the requirements for a criterion of quality control during the thermo temporal melt processing.

The hardening of parts made of alloys by innovative methods of chemical-thermal and combined processing

Ph.D., Associate Prof. K. Kostyk ID http://orcid.org/0000-0003-4139-9970

<u>scientific novelty:</u> the work suggests new nano-sized powder mixtures allowing 10 times nitriding acceleration and 2–3 times boriding acceleration (during furnace heating) as compared to the conventional processes, ensuring the necessary surface hardness and diffusional layers thickness. This effect is achieved due to a much larger quantity of the active saturating atoms and nano-sized particles of powder mixtures. Boriding by induction heating decreases the time to 2–5 minutes and does not cause the grain size growth in the article core which eliminates its brittleness. The amount of saturation mixture, temperature, process duration and heating techniques are optimized.
The new cow-temperature nitriding of titanium alloys combined with the ageing increases the article core strength and reduces the process duration more than 10 times.

<u>practical significance:</u> developed new methods of chemical-thermal treatment, and innovative methods of surface hardening of metal parts. The obtained mathematical model values of the layer depth and surface hardness depending on the temperature and duration of chemical-thermal treatment.