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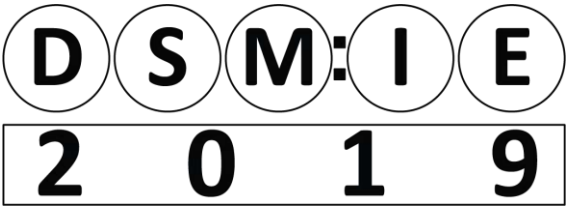
Organized by Sumy State University, Lutsk National Technical University and International Association for Technological Development and Innovations

2nd International Conference on Design, Simulation, Manufacturing: The Innovation Exchange

June 11-14, 2019 | Lutsk, Ukraine

Book of Abstracts

Ministry of Education and Science of Ukraine
Sumy State University



2nd International Conference on Design, Simulation, Manufacturing: The Innovation Exchange (DSMIE-2019)

June 11–14, 2019 | Lutsk, Ukraine

Book of Abstracts

Sumy
University Book
2019

Design, Simulation, Manufacturing: The Innovation Exchange: Book of Abstracts of the 2nd International Conference, Lutsk, Ukraine, June 11-14, 2019 / Vitalii Ivanov, Oleg Zabolotnyi, Oleksandr Liaposhchenko, Ivan Pavlenko, Oleksandr Gusak, Oleksandr Povstyanoy (Eds.). – Sumy, PF «Publishing House "University Book"», 2019. 160 p.

Recommended by Academic Council of Sumy State University
(Minutes of the Meeting No. 12, May 22, 2019)

This book reports on topics at the interface between manufacturing, materials, mechanical, and chemical engineering. It gives special emphasis to CAD/CAE systems, information management systems, advanced numerical simulation methods and computational modeling techniques, and their use in product design, industrial process optimization and in the study of the properties of solids, structures, and fluids. Control theory, ICT for engineering education as well as ecological design and food technologies are also among the topics discussed in the book. Based on the 2nd International Conference on Design, Simulation, Manufacturing: The Innovation Exchange (DSMIE-2019), held on June 11-14, 2019, in Lutsk, Ukraine, the book provides academics and professionals with a timely overview and extensive information on trends and technologies behind current and future developments of Industry 4.0, innovative design and renewable energy generation.

ISBN 978-966-680-903-5

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Welcome Message

2nd International Conference on Design, Simulation, Manufacturing: The Innovation Exchange (DSMIE-2019), held in Lutsk, Ukraine on June 11-14, 2019 was organized by the Sumy State University, Lutsk National Technical University, and International Association for Technological Development and Innovations, in partnership with Technical University of Kosice (Slovak Republic), Kielce University of Technology (Poland), University of West Bohemia (Czech Republic), Poznan University of Technology (Poland), and Association for Promoting Innovative Technologies – Innovative FET (Croatia).

DSMIE-2019 is the international forum for fundamental and applied research and industrial applications in engineering. The conference focuses on a broad range of research challenges in the fields of Manufacturing, Materials, Mechanical, and Chemical Engineering, addressing current and future trends in design approaches, simulation techniques, computer-aided systems, software development, ICT tools and Industry 4.0 strategy implementation for engineering tasks solving. DSMIE-2019 brings together researchers from academic institutions, leading industrial companies, and government laboratories located around the world for promoting and popularization of the scientific fundamentals of manufacturing.

DSMIE-2019 received 190 contributions from 26 countries around the world. After a thorough peer-review process, the Program Committee accepted 92 papers, written by authors from 22 countries. Thank you very much to the authors for their contribution. These papers are published in the present book, achieving an acceptance rate of about 48%. Extended versions of selected best papers will be published in scientific journals: Management and Production Engineering Review (published by De Gruyter and indexed by ISI/ESCI, Scopus), Archives of Mechanical Technology and Materials (Poland), and Journal of Engineering Sciences (Ukraine).

I would like to take this opportunity to thank members of Program Committee and invited external reviewers for their efforts and expertise in contribution to reviewing, without which it would be impossible to maintain the high standards of peer-reviewed papers. 93 Program Committee members and 31 invited external reviewers devoted their time and energy for peer reviewing manuscripts. Our reviewers come from all over the world and represent 29 countries and affiliated with 63 institutions.

Thank you very much to keynote speakers: Jose Machado (Portugal), Justyna Trojanowska (Poland), Ivan Kuric (Slovak Republic), Michal Balog (Slovak Republic),

Dragan Perakovic (Croatia), Grigore Marian Pop (Romania), and Volodymyr Zavialov (Ukraine) for sharing their knowledge and experience.

I appreciate the partnership with Springer, Unicheck, EasyChair, and our Sponsors for their essential support during the preparation of DSMIE-2019.

Thank you very much to DSMIE-2019 Team. Their involvement and hard work were crucial to the success of the DSMIE-2019 conference.

DSMIE's motto is **"Together we can do more for science, technology, engineering and education"**.

***Vitalii Ivanov**,*
General Chair of the Conference

About DSMIE-2019

2nd International Conference on Design, Simulation, Manufacturing: The Innovation Exchange **(DSMIE-2019)** is the international forum for fundamental and applied research and industrial applications in manufacturing.

DSMIE-2019 focuses on a broad range of research challenges in the fields of Manufacturing, Mechanical and Chemical Engineering, addressing current and future trends in design approaches, simulation techniques, computer-aided systems, software development, ICT tools, and Industry 4.0 strategy implementation for engineering tasks solving. DSMIE-2018 brings together researchers from academic institutions, leading industrial companies, and government laboratories located around the world for promoting and popularization of the scientific fundamentals of manufacturing. The conference schedule will include keynote sessions and technical sessions, expert panels, an exhibition of industry partners and more.

The working language of the conference (including conference proceedings, presentations, and discussions) is English.

Conference Committees

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Oleg Zabolotnyi, Lutsk National Technical University, Ukraine

Conference Topics

Manufacturing Engineering

- CAD/CAE Systems for Design of Products, Metalworking Equipment, Fixtures, Cutting Tools
- CAPP/CAM/CAQ Systems for Advanced Manufacturing and Assembling Technologies
- CAx Technologies for Manufacturing Engineering
- Information Management Systems for Manufacturing Enterprises
- Intelligent Manufacturing Systems
- Flexible Manufacturing Systems, Automation and Robotics
- Methods and Technologies for Additive Manufacturing
- Numerical Simulation in Materials Science
- Smart Manufacturing and Industry 4.0 Strategy
- ICT for Engineering Education

Mechanical Engineering

- Engineering Design and Optimization Using CAD/CAE Software
- Using CAE Software in Mechanics of Solids, Structures and Fluids
- Computer Modeling of Fracture, Failure and Fatigue
- Computational Techniques in Machine Mechanics and Dynamics
- Numerical Methods for Dynamics, Acoustics and Vibration
- Computational Methods for Control Theory
- Numerical Simulation of Nonlinear Dynamic Systems
- Simulation Software for Modeling Fluid-Structure Interaction
- Multiphysics Analysis of Coupled Systems

Chemical Engineering

- Theoretical Fundamentals and Mathematical Modeling of Chemical Process Technology
- Computational Fluid Dynamics, Thermodynamics, Heat and Mass Transfer
- Numerical Simulation and Optimization of Industrial Chemical Processes
- CAD/CAM/CAE Systems for Chemical Engineering and Plant Design
- SCADA Process Control Systems for the Chemical Industry
- Resource-Saving and Energy Efficient Technologies, Conversion and Utilization
- Alternative and Renewable Energy, Generation and Recovery
- Biotechnologies and Bioengineering, Bio-based Fuels, Food Technologies
- Industrial Ecology, Sustainable Engineering and Ecological Design

Publishing Opportunities

Full papers of selected contributions of DSMIE-2019 published in Springer Lecture Notes in Mechanical Engineering (ISSN 2195-4356). The books of this series are indexed by Scopus and submitted ISI Proceedings (Web of Science).

Title: Advances in Design, Simulation and Manufacturing II

Subtitle: Proceedings of the 2nd International Conference on Design, Simulation, Manufacturing: The Innovation Exchange, DSMIE-2019, June 11-14, 2019, Lutsk, Ukraine

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- Jose Machado, University of Minho, Portugal
- Oleksandr Liaposhchenko, Sumy State University, Ukraine
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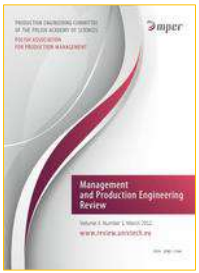
Extended versions of best papers, presented at DSMIE-2018, will be considered for special issues of selected journals, subject to further review:



Management and Production Engineering Review, Poland
(ISSN 2080-8208,
e-ISSN 2082-1344)
http://mper.org

Archives of Mechanical Technology and Materials, Poland
(ISSN 2450-9469)
https://www.degruyter.com/view/j/amtm

Journal of Engineering Sciences, Ukraine
(ISSN 2312-2498,
e-ISSN 2414-9381)
http://jes.sumdu.edu.ua

Organizers

http://dsmie.sumdu.edu.ua

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Sumy State University

Sumy State University is located in Sumy city in the North-East of Ukraine. Its history began in 1948. Today, SumDU is a leading university of a classical type with the III-IV accreditation level in the region.

The University currently serves about 14,000 students who are pursuing pre-bachelor, bachelor, specialist and master degrees in 51 majors and 22 fields of knowledge. About 1600 foreign students represent almost 50 countries worldwide.

Sumy State University is included in Global Research University Profiles (GRUP) by ShanghaiRanking. SSU is also included in the directory of world's best universities by the Times Higher Education World University Rankings. Sumy State University enters the TOP-group (3%) of leading universities of the world and is classified as a university with high research intensity according to the international ranking of higher education institutions QS World University Rankings. According to these rankings, SumDU enters the group of leading Ukrainian universities. SSU also ranked 101-150 among the fastest-rising young stars of the higher education world by the QS. According to the worldwide Internet rankings Webometrics SSU takes 3rd place and uniRank University Ranking - 4th place among Ukrainian universities. It also takes high positions in the European ranking U-Multirank that identifies most of the indicators of academic, extracurricular, international and other activity of SSU as being higher than the world average value.

The University is a signatory of Magna Charta Universitatum and a reliable member of International Association of Universities, European University Association, Euroasian Universities Association, Association of Economic Universities of South

and Eastern Europe and the Black Sea Region, IREG Observatory on Academic Ranking and Excellence, IIENetwork and other international organizations.

Sumy State University cooperates with more than 200 partners from the USA, Great Britain, Germany, Austria, France, Belgium, Sweden, Poland, Lithuania, Bulgaria, the Czech Republic, Slovakia, Romania, Japan, South Korea, China and other countries of the world.

SumDU is a reliable partner for joint projects in frames of international grant programmes of EU (Tempus, Erasmus Mundus, Jean Monnet, Erasmus+, Horizon 2020), United Nation Development Programme, British Council, the World Bank, bilateral scientific and research projects, grants of private foundations. The University accomplishes more than 200 grants annually. For the last 5 years, the amount of research work in frames of international grant projects has increased in 20 times.

The University actively develops academic mobility programmes, including long-term and short-term studying, internships and placement programmes for undergraduate and postgraduate students, research and teaching staff, as well as administrative staff using technologies of credit transfer and recognition of academic results.

According to SCOPUS database, Sumy State University holds a leading position among Ukrainian higher education and research institutions for h-index (the index of research impact) and the number of citations by the international academic community.

There are more than 3000 employees in the university, including Corresponding Members of the National Academy of Science of Ukraine, 130 Doctors of Sciences, Professors and 660 Candidates of Sciences (Ph.D.), Associate Professors represent the academic staff of the University. There are postgraduate and post-doctoral programmes in 21 majors, degree awarding academic councils.

According to the number of commercial contracts and grants, and the efficiency of use of budget funds, Sumy State University is one of the leaders among Ukrainian universities.

✉ 2 Rymskogo-Korsakova St., Sumy, 40007, Ukraine
💻 http://sumdu.edu.ua

Lutsk National Technical University

Lutsk National Technical University (Lutsk NTU) was established in 1966 and in 2008 received the status of a National University. It is situated in Lutsk, Volyn region, located in northwest Ukraine. The University occupies an area of 60,990,000 square meters. Four buildings of Lutsk NTU are well-equipped with modern facilities for study and research. Lutsk NTU Sports Complex with 25 meters long pool, a stadium, a gym, two fitness centers and a room for aerobics offer students and people of all ages a wide range of sports, leisure, and recreational pursuits, aimed to provide our customers with quality sports, health and fitness experience.

Nowadays the university comprises 7 Faculties, 35 departments, 3 centers, 3 technical colleges. The total number of academic staff is 400 persons, among them 45 Doctors of Science and Professors, 276 Candidates of Science and Associate Professors, Academicians and Corresponding Members of branch academies. The academic staff of the university's departments takes an active part in the external relations with the learners, research partners, business people. Lutsk NTU prepares professionals in more than 30 specialties on 7 faculties.

Scientific and pedagogical activity is one of the priorities of the University. Lutsk NTU implements 7 state budget projects and 23 projects on companies' order. As a result of these projects about 100,000 euros have been drawn by University. According to the admission campaign Lutsk NTU is the 25th in the number of places enrolled to obtain a master's degree, and the 26th in the number of places enrolled to obtain a bachelor's degree.

Lutsk NTU has extensive experience in different EU-funded programmes (Tempus, Erasmus+, CBC Poland-Belarus-Ukraine, Eastern Partnership Territorial Cooperation Programme Belarus-Ukraine and others) and international programs (British Council, American Councils for International Education, IDEA II, Visegrad Fund and others). So during last year Lutsk NTU submitted 45 full application forms for these programmes 3 of them were selected for financing, and 23 application forms wait for final decision). Lutsk NTU is one of 10 Ukrainian universities working in Strengthening Academic Integrity in Ukraine Project – SAIUP. Moreover, Lutsk NTU is the only University in Ukraine which implemented 3 projects within the partnership with the American Councils. Lutsk NTU actively cooperates in the field of education and science with more than 60 partners from 20 countries.

✉ 75 Lvivska St., Lutsk, 43018, Ukraine
💻 http://lutsk-ntu.com.ua

International Association for Technological Development and Innovations

International Association for Technological Development and Innovations (IATDI) is a non-government organization and a professional community established for fostering and promoting innovations to the science, technology, and education.

IATDI is a platform for providing a communication channel with IATDI Academic and Industrial Partners, involving members to IATDI International Scientific Events for innovation exchange with obtaining a certificate, getting a discount for participation in conferences supported by IATDI, priority publishing in scientific journals supported by IATDI.

✉ 5 Mykhayla Lushpy Ave., 30/29, Sumy, 40035, Ukraine

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In May 2009, the supervisory audit was successfully conducted on a new version of the standard ISO 9001:2008 auditors Bureau Veritas Certification Ukraine. The drawbacks identified during the audit were promptly removed. On the results of the audit the certificate for the new version of ISO 9001:2008 was issued.

✉ 4 Rivnenska St., Strumovka 45603, Volyn region, Ukraine
💻 https://modern-expo.com

Bogdan Motors

State Enterprise "Automobile assembly plant № 1" JSC Automobile company "Bogdan Motors" is an Ukrainian automobile design company consisting of Bogdan Corporation, an industrial manufacturer of buses, trolleybuses and electric buses under the brand "Bogdan". The main task of this enterprise is the production of buses of small, medium and large classes, trolleybuses of various modifications and electric buses.

✉ 42 Rivnenska St., Lutsk, 43010, Ukraine
💻 http://busplant.bogdan.ua

Lutsk City Council

Lutsk City Council is a public administration body.

✉ 19 Bohdana Khmelnytskoho St., Lutsk, 43000, Ukraine
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информационно-аналитический международный технический журнал

Monthly international magazine «Industry in FOCUS» has already attracted attention of many companies who work at the industrial market. Time of feverish activity made our edition the most popular among the similar journals.

The editorial policy of «Industry in FOCUS» consists of prompting information bridges between developers of technics and technical processes, producers of the industrial output, providers and consumers. Since our market develops dynamically and our technical specialists should be well-informed we use the authority and status of our edition to cover the field broadly and give irreversible character to those processes which are taken place in our country now.

As was observed, our edition is useful for the big circle of engineers, businessmen, and main specialists of industrial enterprises.

The Circulation of our journal is 10 thousand copies. It is circulated with the subscription in Ukraine, Russia, Czech Republic, Poland, France, Germany, Israel and Belarus. Besides that, «Industry in FOCUS» journal takes active part in different profile exhibitions, seminars, conferences in many countries of the world where your advertisement can be matched.

Constant sections:

- “RELEVANT” (economic news, exhibitions, seminars, conferences);
- “COVERAGE SECTOR” (enterprise news, branch problems, market reviews);
- “EQUIPMENT” (advantages and specifications of different mechanisms, machines, devices);
- “TOOLS” (Characteristics of the metal cutting tool, specification of manufacture and use);
- “AUTOMATICS” (means of industrial automation, analysis and estimation of the automation system);
- “TECHNOLOGIES” (advanced technologies, modern means of manufacture);
- “TECHNO-plus” (“magazine in magazine”, topical selection of articles);

- “TRADING HALL OF INDUSTRIAL EQUIPMENT” (information about metal cutting equipment, which was in use, accessories to it, and announcements of repair, restoration and modernization the equipment);

Special sections: “ECOLOGY”,“ENERGY SAVING”, “SPECIAL INFORM”, “YOUR PARTNERS”, “THE POINT OF VIEW”.

Your advertisement can be placed in the form of an advertisement block or an article about your company’s activity. The commercial effect of such publication will be maximum if you tell your potential clients the following:

- Briefly about your company, plans of its development;
- About the nomenclature of your production and the domain of their application;
- In detail-about the important characteristics (comparison with an analog is desirable), peculiarities, and so on.

✉ PO Box 2849, Kharkiv, 61085, Ukraine
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Conference Program

Day 1 – **June 11, 2019** – Tuesday		
0^{00}–24^{00}	Day of Arrival	
Day 2 – **June 12, 2019** – Wednesday		
8^{00}–9^{00}	Registration	
9^{00}–9^{30}	Opening Ceremony	
9^{30}–11^{00}	Keynote Session 1	
11^{00}–11^{10}	Photo Session	
11^{10}–11^{30}	Coffee Break	
11^{30}–13^{00}	Keynote Session 2	
13^{00}–14^{00}	Lunch	
14^{00}–15^{30}	Session 1 Manufacturing Engineering I	
15^{30}–15^{45}	Coffee Break	
15^{45}–17^{30}	Session 2 Manufacturing Engineering II	
19^{00}–22^{00}	DSMIE-2019 Welcome Dinner	
Day 3 – **June 13, 2019** – Thursday		
9^{00}–11^{00}	Session 3 Manufacturing Engineering III	Session 4 Chemical Engineering I
11^{00}–11^{20}	Coffee Break	
11^{20}–13^{00}	Session 5 Mechanical Engineering I	Session 6 Chemical Engineering II
13^{00}–14^{00}	Lunch	
14^{00}–15^{30}	Session 7 Mechanical Engineering II	Session 8 Manufacturing Engineering IV
15^{30} – 17^{00}	Industry Tour	
17^{00}–19^{00}	City Tour	
Day 4 – **June 14, 2019** – Friday		
9^{00}–11^{00}	Session 9 Manufacturing Engineering V	Session 10 Mechanical Engineering III
11^{00}–11^{20}	Coffee Break	
11^{20}–13^{00}	Session 11 Manufacturing Engineering VI	
13^{00}–14^{00}	Closing Ceremony, Awards and Farewell	

Day 1: June 11, 2019, Tuesday

Venue: Lutsk, 43000, Ukraine
50°45′00″N 25°20′09″E

	Day of Arrival
14^{00}–16^{30}	**University Tour**

Lutsk is an ancient Slavic town, mentioned in the Hypatian Chronicle as Luchesk in the records of 1085. The etymology of the name is unclear. There are three hypotheses: either the name may have been derived from the old-Slavic word luka (an arc or bend in a river), or the name may have originated from Luka (the chieftain of the Dulebs), an ancient Slavic tribe living in this area. The name may have also been derived from Luchanii (Luchans), an ancient branch of the tribe mentioned above.

Day 2: June 12, 2019, Wednesday

Venue: "Passage Interdit"
42 Naberezhna St., Lutsk, 43000, Ukraine
https://passageinterdit.com.ua

8^{00}–9^{00}	**Registration**
9^{00}–9^{30}	**Opening Ceremony**

Vitalii Ivanov
General Chair of the Conference
Oleg Zabolotnyi
Co-chair of the Conference
Petro Savchuk
Rector of the Lutsk National Technical University, Ukraine
Oleksandr Gusak
Dean of the Faculty of Technical Systems and Energy Efficient Technologies of Sumy State University, Ukraine

9^{30}–11^{00}	**Keynote Session 1** *Chair: Vitalii Ivanov* Sumy State University, Ukraine

Mechatronic Medical Assistive Devices – Paradigms on Design Tasks Considering Final Purposes
Jose Machado
University of Minho, Portugal
Smooth and Economic Production for Everyone
Justyna Trojanowska
Poznan University of Technology, Poland
Challenges and Issues of ICT in Industry 4.0
Dragan Perakovic, Marko Perisa and Petra Zoric
University of Zagreb, Croatia

11^{00}–11^{10}	**Photo Session**
11^{10}–11^{30}	**Coffee Break**

11^{30}–13^{00}	**Keynote Session 2** *Chair: Olaf Ciszak* Poznan University of Technology, Poland

Regularities of Solid-phase Continuous Vibration Extraction and Prospects for its Industrial Use

Volodymyr Zavialov, Taras Mysiura, Nataliia Popova, Valerii Sukmanov and Valentyn Chornyi

National University of Food Technologies, Ukraine

Introduction of Modular Charging Stations Based on IoT with the Possibility of Implementation to Automotive Industry

Michal Balog

Technical University of Kosice, Slovak Republic

The Effectiveness of ICT Tools for Engineering Education

Grigore Marian Pop, Liviu Adrian Crisan and Mihai Tripa

University of Cluj-Napoca, Romania

13^{00}–14^{00}	**Lunch**
14^{00}–15^{30}	**Session 1 – Manufacturing Engineering I** *Chair: Slawomir Luscinski,* Kielce University of Technology, Poland

Case Study of Model-Based Definition and Mixed Reality Implementation in Product Lifecycle

Dmytro Adamenko, Robin Pluhnau and Arun Nagarajah

University Duisburg-Essen, Germany

Design Optimization Techniques in Mechanical Design and Education of Engineers

Peter Arras[1] and Galyna Tabunshchyk[2]

[1] KU Leuven University, Belgium

[2] Zaporizhzhia National Technical University

Increasing the Efficiency of the Production Process due to Using Methods of Industrial Engineering

Pavel Kabele and Milan Edl

University of West Bohemia, Czech Republic

Effects of the Combined Laser-Ultrasonic Surface Hardening Induced Microstructure and Phase State on Mechanical Properties of AISI D2 Tool Steel

Dmytro Lesyk[1], Silvia Martinez[2], Bohdan Mordyuk[3], Vitaliy Dzhemelinskyi[1] and Oleksandr Danyleiko[1]

[1] National Technical University of Ukraine "Igor Sikorsky Kyiv Polytechnic Institute", Ukraine

[2] University of the Basque Country, Spain

[3] G.V. Kurdyumov Institute for Metal Physics of the NAS of Ukraine, Ukraine

An Updated Portrait of Numerical Analyses on Spout-Fluidized Bed Incineration Systems

Emrah Ozahi[1], Arif Cutay[2], Aysegul Abusoglu[1] and Alperen Tozlu[2]

[1] Gaziantep University, Turkey

[2] Bayburt University, Turkey

Experimental and Analytical Study of CBN Grinding of Welded Martensitic Aging Steel

Vladimir Lebedev, Vladimir Tonkonogyi, Tatiana Chumachenko, Nataliya Klymenko and Olga Frolenkova

Odessa National Polytechnic University, Ukraine

The Study of Surface Microgeometry and Morphology of Plasma Electrolytic Oxidation Dielectric Coatings on Aluminum Alloys

Elena Sevidova[1], Yuriy Gutsalenko[1], Aleksandr Rudnev[1], Larisa Pupan[1] and Oksana Titarenko[2]

[1] National Technical University «Kharkiv Polytechnic Institute», Ukraine

[2] National Academy of the National Guard of Ukraine, Ukraine

Creative, Quality Oriented Rethinking of the Assessment Strategy at the University Level Courses. A Case Study

Alina Narcisa Crisan[1] and Grigore Pop[2]

[1] University of Agricultural Sciences and Veterinary Medicine, Romania

[2] Technical University of Cluj-Napoca, Romania

15^{30}–15^{45} **Coffee Break**

15^{45}–17^{30} Session 2 – Manufacturing Engineering II

Chair: Jan Pitel
Technical University of Kosice, Slovak Republic

Prediction of Lankford Coefficients for AA1050 and AA5754 Aluminum Sheets using Uniaxial Tensile Tests and Cup Drawing Experiments

Sadık Olguner and Ali Tolga Bozdana
Gaziantep University, Turkey

Simulation Study of Cutting-Induced Residual Stress

Vadym Stupnytskyy and Ihor Hrytsay
Lviv Polytechnic National University, Ukraine

ICT Support for Industry 4.0 Innovation Networks: Education & Technology Transfer Issues

Teofilo Tirto[1], Yuriy Ossik[2] and Vitaliy Omelyanenko[3]
[1] FARADI SRL, Italy
[2] Sumy State University, Ukraine
[3] Sumy State Pedagogical University named after A.S. Makarenko, Ukraine

A Simulation Tool for Kinematics Analysis of a Serial Robot

Mehmet Erkan Kutuk[1], Lale Canan Dulger[2] and Memik Taylan Das[3,4]
[1] Gaziantep University, Turkey
[2] Izmir University of Economics, Turkey
[3] University of Waterloo, Canada
[4] Kirikkale University, Turkey

Finite-Element Model of Bimetal Billet Strain Obtaining Box-Shaped Parts by Means of Drawing

Tetiana Haikova[1], Ruslan Puzyr[2], Vladimyr Dragobetskuy[1], Anastasiya Symonova[1] and Roman Vakulenko[1]
[1] Kremenchuk Mykhailo Ostrohradskyi National University, Ukraine
[2] Kremenchuk Mykhailo Ostrohradskyi National University College, Ukraine

The Application of the Uncorrected Tool with a Negative Rake Angle for Tapered Thread Turning

Volodymyr Kopei, Oleh Onysko and Vitalii Panchuk
Ivano-Frankivsk National Technical University of Oil and Gas, Ukraine

Numerical Deflections Analysis of Variable Low Stiffness of Thin-Walled Parts during Milling

Sergey Dobrotvorskiy, Yevheniia Basova, Serhii Kononenko, Ludmila Dobrovolska and Maryna Ivanova

National Technical University "Kharkiv Polytechnic Institute", Ukraine

Estimation of Temperature Levels in the Area of Polishing with Polymer-Abrasive Brushes

Natalia Honchar[1], Eduard Kondratiuk[2], Dmytro Stepanov[1], Pavlo Tryshyn[1] and Olena Khavkina[1]

[1] Zaporizhzhya National Technical University, Ukraine

[2] Zaporizhzhia Machine-building Design Bureau "Ivchenko-Progress", Ukraine

Energy Criterion for Metal Machining Methods

Yurii Yarovyi and Inna Yarova

Odessa National Polytechnic University, Ukraine

19^{00}–22^{00} **DSMIE-2019 Welcome Dinner**

Day 3: June 13, 2019, Thursday

Venue	"Direktoria" Business Center
for Sessions 3, 5, 7:	26 Vynnychenka St., Lutsk, 43000, Ukraine
	http://www.direktoria.com.ua
Venue	"Hotel Complex "Ukraine", Congress Center #2
for Sessions 4, 6, 8:	2 Slovatskogo St., Lutsk, 43025, Ukraine
	http://hotel-lutsk.com/en

9^{00}–11^{00} **Session 3 – Manufacturing Engineering III**

Chair: Dagmar Caganova

Slovak Technical University, Slovak Republic

Modeling of Mixing Bulk Materials

Igor Dudarev, Ruslan Kirchuk, Yurii Hunko and Svitlana Panasyuk

Lutsk National Technical University, Ukraine

Analysis of the Involute and Sinusoidal Gears by the Operating Parameters and a New Method of its Cutting

Ihor Hrytsay and Vadym Stupnytskyy

Lviv Polytechnic National University, Ukraine

Recruitment Web-Service Management System Using Competence-Based Approach for Manufacturing Enterprises

Vitaliy Kobets, Nikita Tsiuriuta, Valerii Lytvynenko, Mykola Novikov and Sergey Chizhik

Kherson State University, Ukraine

Simulation of Induction Heating for Railway Wheel Set Elements During Assembly and Disassembly

Oleksandr Kupriyanov and Serhey Romanov

Ukrainian Engineering Pedagogics Academy, Ukraine

Forecasting of Overloading Volumes in Transport Systems based on the Fuzzy-Neural Model

Natalya Shramenko[1,2] and Dmitriy Muzylyov[1]

[1] Kharkiv Petro Vasylenko National Technical University of Agriculture, Ukraine

[2] Ukrainian State University of Railway Transport, Ukraine

Determination of Parameters of Cylindrical Grinding with Additional Intermediate Dressing

Mykhaylo Stepanov[1], Larysa Ivanova[2], Petro Litovchenko[2], Maryna Ivanova[1] and Yevheniia Basova[1]

[1] National Technical University «Kharkiv Polytechnic Institute», Ukraine

[2] National Academy of the National Guard of Ukraine, Ukraine

Numerical Prediction of the Elastic and Strength Properties of Woven Composites

Andriy Mikhalkin[1], Oleksii Petrov[1], Igor Kravchenko[1], Gennadiy Lvov[2] and Olga Kostromytska[2]

[1] ZMDB Progress SE named after academician A.G. Ivchenko, Ukraine

[2] National Technical University «Kharkiv Polytechnic Institute», Ukraine

Application of Microphotogrammetric and Material Science Techniques in the Study of Materials on the Example of Alloy AlZnMgCu

Anna Uhl[1], Yuliia Melnyk[1], Oleksandr Melnyk[1], Inna Boyarska[2] and Mykola Melnychuk[2]

[1] Lesya Ukrainka Eastern European National University, Ukraine

[2] Lutsk National Technical University, Ukraine

Temperature Field Analysis in Grinding

Natalia Lishchenko[1] and Vasily Larshin[2]

[1] Odessa National Academy of Food Technologies, Ukraine

[2] Odessa National Polytechnic University, Ukraine

Technology Support for Protecting Contacting Surfaces of Half-Coupling – Shaft Press Joints Against Fretting Wear

Vasyl Martsynkovskyy[1], Viacheslav Tarelnyk[1], Ievgen Konoplianchenko[1], Oksana Gaponova[2] and Mykhailo Dumanchuk[1]

[1] Sumy National Agrarian University, Ukraine

[2] Sumy State University, Ukraine

9^{00}–11^{00} **Session 4 – Chemical Engineering I**

Chair: Michae Tseitlin

National Technical University "Kharkiv Polytechnic Institute", Ukraine

Low-Frequency Ultrasound as an Effective Method of Energy Saving During Forming of Reactoplastic Composite Materials

Aleksandr Kolosov, Elena Kolosova, Dmytro Sidorov and Anish Khan

[1] National Technical University of Ukraine «Igor Sikorsky Kyiv Polytechnic Institute», Ukraine

[2] King Abdulaziz University, Saudi Arabia

Numerical Simulation of Aeroelastic Interaction between Gas-Liquid Flow and Deformable Elements in Modular Separation Devices

Oleksandr Liaposhchenko[1], Ivan Pavlenko[1], Katarina Monkova[2], Marina Demyanenko[1] and Oleksandr Starynskyi[1]

[1] Sumy State University, Ukraine

[2] Technical University of Kosice, Slovak Republic

Significance of Swirl Flow Separator Modification in Rainwater Treatment Technology

Małgorzata Markowska, Marek Ochowiak, Sylwia Włodarczak, Szymon Woziwodzki and Magdalena Matuszak

Poznan University of Technology, Poland

Semi-Empirical Correlations of Pollution Processes on the Condensation Surfaces of Exhaust Gas Boilers with Water-Fuel Emulsion Combustion

Mykola Radchenko[1], Roman Radchenko[1], Victoria Kornienko[2] and Maxim Pyrysunko[2]

[1] Admiral Makarov National University of Shipbuilding, Ukraine

[2] Kherson Branch of Admiral Makarov National University of Shipbuilding, Ukraine

Development of Technology for Utilization of Sulphate Waste Water of Detergents Production

Zurab Megrelishvili[1], Ibraim Didmanidze[1] and Vladimir Zaslavskiy[2]

[1] Batumi Shota Rustaveli State University, Georgia

[2] Taras Shevchenko National University, Ukraine

Production of Pumpkin Pectin Paste

Yuriy Sukhenko, Mikhailo Mushtruk, Volodimir Vasyliv, Vladislav Sukhenko and Vladislav Dudchenko

National University of Life and Environmental Sciences of Ukraine, Ukraine

Influence of Difference in Density of Solids on Mixing Efficiency in the Designed Static Mixer

Marek Ochowiak, Andżelika Krupińska, Sylwia Włodarczak, Magdalena Matuszak and Małgorzata Markowska

Poznan University of Technology, Poland

The Process of Environmentally Safe Biochemical Recycling of Phosphogypsum

Leonid Plyatsuk[1], Magdalena Balintova[2], Yelizaveta Chernysh[1], Iryna Ablieieva[1] and Oleksiy Ablieiev[1]

[1] Sumy State University, Ukraine

[2] Technical University of Kosice, Slovak Republic

Assessment of the Quality of Alternative Fuels for Gasoline Engines

Valentyna Tkachuk[1], Taras Bozhydarnik[1], Oksana Rechun[1], Taras Karavayev[2] and Nina Merezhko[2]

[1] Lutsk National Technical University, Ukraine

[2] Kyiv National University of Trade and Economics, Ukraine

Kinetics of Sodium Chloride Dissolution in Condensates Containing Ammonia and Ammonium Carbonates

Michael Tseitlin, Valentina Raiko and Aleksei Shestopalov

National Technical University “Kharkiv Polytechnic Institute”, Ukraine

11^{00}–11^{20} **Coffee Break**

11^{20}–13^{00} **Session 5 – Mechanical Engineering I**

Chair: Milan Edl

University of West Bohemia, Czech Republic

Method for Determination Flow Characteristic in the Gas Turbine System

Olena Avdieieva, Oksana Lytvynenko, Iryna Mykhailova and Oleksandr Tarasov

National Technical University "Kharkiv Polytechnic Institute", Ukraine

Choice of Correcting Link for Electrohydraulic Servo Drive of Technological Equipment

Volodymyr Sokolov, Oleg Krol and Oksana Stepanova

Volodymyr Dahl East Ukrainian National University, Ukraine

Cutting Stone Building Materials and Ceramic Tiles with Diamond Disc

Ala Bezpalova[1], Vladimir Lebedev[2], Vladimir Tonkonogyi[2], Yuri Morozov[2] and Olga Frolenkova[2]

[1] Odessa State Academy of Civil Engineering and Architecture, Ukraine

[2] Odessa National Polytechnic University, Ukraine

Static and Flow-Rate Characteristics of Centrifugal Pump's Balancing Device with Considering the Random Changes of Its Main Parameters

Yuliia Tarasevych[1], Ievgen Savchenko[2] and Nataliia Sovenko[2]

[1] AGH University of Science and Technology, Poland

[2] Sumy State University, Ukraine

Simulating the Process of a Bird Striking a Rigid Target

Natalia Smetankina[1], Sergey Ugrimov[1], Igor Kravchenko[2] and Dmitry Ivchenko[2]

[1] A. Podgorny Institute of Mechanical Engineering Problems of the National Academy of Sciences of Ukraine, Ukraine

[2] SE Ivchenko-Progress, Ukraine

Wear Resistance of Hardened Nanocrystalline Structures in the Course of Friction of Steel -Grey Cast Iron Pair in Oil-Abrasive Medium

Ihor Hurey[1,2], Tetyana Hurey[1] and Volodymyr Gurey[1]

[1] Lviv Polytechnic National University, Ukraine

[2] Rzeszow University of Technology, Poland

Control of Operation Modes Efficiency of Complex Technological Facilities based on the Energy Efficiency Monitoring

Liudmyla Davydenko[1], Viktor Rozen[2], Volodymyr Davydenko[3] and Nina Davydenko[3]

[1] Lutsk National Technical University, Ukraine

[2] National Technical University of Ukraine "Igor Sikorsky Kyiv Polytechnical Institute", Ukraine

[3] National University of Water and Environmental Engineering, Ukraine

Improvement of the Hydraulic Units Design based on CFD Modeling

Oleksandr Petrov, Leonid Kozlov, Dmytro Lozinskiy and Oleh Piontkevych

Vinnytsia National Technical University, Ukraine

11^{20}–13^{00} Session 6 – Chemical Engineering II

Chair: Oleksandr Liaposhchenko
Sumy State University, Ukraine

Patterns of Pollutants Distribution from Vehicles to the Roadside Ecosystems

Iryna Vaskina, Leonid Plyatsuk, Roman Vaskin, Iryna Ablieieva and Serhii Sydorenko

Sumy State University, Ukraine

Studies on a Simplex Pressure-Swirl Atomizers with a Different Spin Chamber Shape

Sylwia Włodarczak, Marek Ochowiak, Andżelika Krupińska, Marcin Janczarek and Magdalena Matuszak

Poznan University of Technology, Poland

Evaluation of Energy and Ecological Indicators of Motor Biofuels

Victor Zaharchuk, Oleg Zaharchuk, Valerij Dembitskij, Vasiliy Ivanciv and Sergiy Pankevich

Lutsk National Technical University, Ukraine

Properties of Heat and Mass Transfer Processes in the Tubular Grids with Heat Exchanger as Stabilizer

Viktor Moiseev[1], Oleksandr Liaposhchenko[2], Peter Trebuna[3], Eugenia Manoilo[1] and Oleg Khukhryanskiy[2,4]

[1] National Technical University «Kharkiv Polytechnic Institute», Ukraine
[2] Sumy State University, Ukraine
[3] Technical University of Kosice, Slovak Republic
[4] PJSC «UKRHIMPROEKT», Ukraine

Calculation of the Residence Time of Dispersed Phase in Sectioned Devices: Theoretical Basics and Software Implementation

Viktor Obodiak, Nadiia Artyukhova and Artem Artyukhov

Sumy State University, Ukraine

CFD Assessment of Jet Flow Behavior in an Alternative Design of a Spray Dryer Chamber

Saad N. Saleh[1], Omer Saaed[1] and Maksym Skydanenko[2]

[1] Tikrit University, Iraq
[2] Sumy State University, Ukraine

13^{00}–14^{00} Lunch

14^{00}–15^{30} Session 7 – Mechanical Engineering II

Chair: Ivan Pavlenko
Sumy State University, Ukraine

Influence of Discrete Electromechanical Hardening on the Wear Resistance of Steels

Aleksandr Dykha, Oleg Makovkin and Maksym Dykha
Khmelnitsky National University, Ukraine

Parallel Solution of Dynamic Elasticity Problems

Ivan Dyyak, Vitaliy Horlatch and Marianna Salamakha
Ivan Franko National University of Lviv, Ukraine

Efficiency Analysis of Gas Turbine Plant Cycles with Water Injection by the Aerothermopressor

Dmytro Konovalov and Halina Kobalava
Admiral Makarov National University of Shipbuilding, Ukraine

The Imitation Study of Taper Connections Stiffness of Face Milling Cutter Shank Using Machine Spindle in the Solidworks Simulation Environment

Oleksandr Melnyk, Larysa Hlembotska, Nataliia Balytska, Viacheslav Holovnia and Mykola Plysak
Zhytomyr State Technological University, Ukraine

Calculation Optimization of Complex Shape Shells by Numerical Method

Ruslan Pasichnyk, Oksana Pasichnyk, Olha Uzhehova, Olexsandr Andriichuk and Olexandr Bondarskyy
Lutsk National Technical University, Ukraine

The Investigation of Particle Movement on a Helical Surface

Sergiy Pylypaka[1], Viktor Nesvidomin[1], Tatiana Zaharova[2], Olexandr Pavlenko[3] and Mikola Klendiy[4]
[1] National University of Life and Environmental Sciences of Ukraine, Ukraine
[2] Sumy National Agrarian University, Ukraine
[3] Bohdan Khmelnytsky Melitopol State Pedagogical University, Ukraine
[4] Beregany Agricultural Institute of National University of Life and Environmental Sciences of Ukraine, Ukraine

Calculation of Hydrostatic Forces of Multi-Gap Seals and Its Dependence on Shaft Displacement

Oleksandr Pozovnyi, Andriy Deineka and Dmytro Lisovenko
Sumy State University, Ukraine

Improvement of Manufacture Workability for Distribution Systems of Planetary Hydraulic Machines

Angela Voloshina, Anatolii Panchenko, Oleg Boltyansky and Olena Titova

Tavria State Agrotechnological University, Ukraine

14^{00}–15^{30} **Session 8 – Manufacturing Engineering IV**

Chair: Volodymyr Tonkonogyi

Odessa National Polytechnic University, Ukraine

Technical-Economic Aspects of the Use of Technological Process of Deforming Broaching

Yakiv Nemyrovskyi[1], Eduard Posvyatenko[2] and Sergii Sardak[3]

[1] Central Ukrainian National Technical University, Ukraine

[2] National Transport University, Ukraine

[3] Oles Honchar Dnipro National University, Ukraine

Investigation of the Dynamic State of Adjustable Milling Heads

Pavlo Kushnirov[1], Dmytro Zhyhylii[1], Oleksandr Ivchenko[1], Artem Yevtukhov[1] and Oksana Dynnyk[2]

[1] Sumy State University, Ukraine

[2] Konotop Institute of Sumy State University, Ukraine

The Data Integration Technology of Industrial Information Systems

Petro Pavlenko[1], Vira Shendryk[2], Kostyantyn Balushok[3] and Stanislav Doroshenko[4]

[1] National Aviation University, Ukraine

[2] Sumy State University, Ukraine

[3] Motor Sich JSC, Ukraine

[4] Sumy NPO PJSC, Ukraine

Improvement of the Technology of Tribostate Application of Powder Paints Using Fractal Analysis of Spray Quality

Serhii Pustiulha, Ihor Holovachuk, Volodymyr Samchuk, Viktor Samostian and Valentyn Prydiuk

Lutsk National Technical University, Ukraine

A New Technology for Producing the Polystyrene Foam Molds Including Implants at Foundry Industry

Olga Ponomarenko[1], Natalya Yevtushenko[1], Tatiana Lysenko[2], Liudmyla Solonenko[2] and Vladimir Shynsky[3]

[1] National Technical University "Kharkiv Politechnic Institute", Ukraine

[2] Odessa National Polytechnic University, Ukraine

[3] Physico-technological Institute of Metals and Alloys of the National Academy of Sciences of Ukraine, Ukraine

Implementation of Pipe Steel Grade X52M Manufacturing according to API-5L Requirements Applied to Hot Rolling Mills "1700"

Oleksandr Kurpe[1], Volodymyr Kukhar[2], Eduard Klimov[3], Sergii Chernenko[3] and Elena Balalayeva[2]

[1] METINVEST HOLDING, LLC, Ukraine

[2] Pryazovskyi State Technical University, Ukraine

[3] Kremenchuk Mykhailo Ostrohradskyi National University, Ukraine

Simulation of the Influence of High-voltage Pulsed Potential Supplied During the Deposition on the Structure and Properties of the Vacuum-Arc Nitride Coatings

Nataliya Pinchuk and Oleg Sobol

National Technical University "Kharkiv Polytechnic Institute", Ukraine

Physical-Mechanical Properties and Structural-Phase State of Nanostructure Wear-Resistant Coatings Based on Nitrides of Metals W and Cr

Kostiantyn Dyadyura and Valentina Pererva

Sumy State University, Ukraine

$15^{30} – 17^{00}$ **Industry Tour**

Chair: Mykola Melnychuk

Lutsk National Technical University, Ukraine

"Modern-Expo" Ltd.

https://modern-expo.com

***Modern-Expo Group** is an international holding, leading manufacturer and supplier of the complete retail solution in Central and Eastern Europe.*

"SKF Ukraine"

https://www.skf.com/ua/uk/index.html

***PJSC "SKF Ukraine"**, a part of the SKF corporation, is the only one Ukrainian manufacturer of roller bearings and components for them.*

17^{00}–19^{00} **City Tour**

Lutsk Castle

Also locally known as Lubart's Castle or Upper Castle, began its life in the mid-14th century as the fortified seat of Gediminas' son Liubartas (Lubart), the last ruler of united Galicia-Volhynia. It is the most prominent landmark of Lutsk and as such appears on the 200-hryvnia bill.

Day 4: June 14, 2019, Friday

Venue: "Direktoria" Business Center
26 Vynnychenka St., Lutsk, 43000, Ukraine
http://www.direktoria.com.ua

9^{00}–11^{00} **Session 9 – Manufacturing Engineering V**
Chair: Viliam Zaloga
Sumy State University, Ukraine

Technological Assurance and Features of Fork-Type Parts Machining
Vitalii Ivanov[1], Ivan Dehtiarov[1], Ivan Pavlenko[1], Mykyta Kosov[1] and Michal Hatala[2]
[1] Sumy State University, Ukraine
[2] Technical University of Kosice, Slovak Republic

Improvement of Manufacturing Technology and Recovery of Clamping Collets for Lathe Automats
Rostyslav Redko, Oleg Zabolotnyi, Olga Redko, Serhii Savchuk and Volodymyr Kovalchuk
Lutsk National Technical University, Ukraine

Prospects of the Implementation of Modular Charging Stations Based on IoT to the Infrastructure of the Automotive Industry
Michal Balog[1], Angelina Iakovets[1] and Hanna Sokhatska[2]
[1] Technical University of Kosice, Slovak Republic
[2] Kyiv National University of Technology and Design, Ukraine

Experimental Vibrating Complex for the Research of Pressing Processes of Powder Materials
Dmytro Somov, Oleg Zabolotnyi, Roman Polinkevich, Bohdan Valetskyi and Viktor Sychuk

Lutsk National Technical University, Ukraine

Functional Properties of PTFE-composites Produced by Mechanical Activation
Kristina Berladir[1], Oleksandr Gusak[1], Maryna Demianenko[1], Jozef Zajac[2] and Anatoliy Ruban[1]
[1] Sumy State University, Ukraine
[2] Technical University of Kosice, Slovak Republic

Information Support for the Quality Management System Assessment of Engineering Enterprises

Oksana Dynnyk[1], Yuliia Denysenko[2], Viliam Zaloga[2], Oleksandr Ivchenko[2] and Tetiana Yashyna[1]

[1] Konotop Institute of Sumy State University, Ukraine

[2] Sumy State University, Ukraine

The Effect of The Hardfacing Processes Parameters on The Carbide Volume Fraction

Marek Gucwa[1], Jerzy Winczek[1], Sławomir Parzych[2] and Marcin Kukuryk[1]

[1] Czestochowa University of Technology, Poland

[2] Cracov University of Technology, Poland

Directed Formation of Quality, as a Way of Improving the Durability of Conjugated Parts of Friction Pairs

Anatolii Tkachuk, Valentyn Zablotskyi, Andriy Kononenko, Serhii Moroz and Stanislav Prystupa

Lutsk National technical University, Ukraine

9^{00}–11^{00} **Session 10 – Mechanical Engineering III**

Chair: Oleksandr Povstyanoy

Lutsk National Technical University, Ukraine

Cavitation in Nozzle: The Effect of Pressure on the Vapor Content

Oleh Chekh[1], Serhii Sharapov[1], Maxim Prokopov[1], Viktor Kozin[1] and Dariusz Butrymowicz[2]

[1] Sumy State University, Ukraine

[2] Bialystok University of Technology, Poland

Dynamic Stress State of Auxetic Foam Medium Under the Action of Impulse Load

Olena Mikulich, Lyudmila Samchuk and Yulia Povstiana

Lutsk National Technical University, Ukraine

Data Acquisition Procedures for A&DM Systems Dedicated for the Foundry Industry

Robert Sika and Zenon Ignaszak

Poznan University of Technology, Poland

Improvement the Performance of Liquid Purification by Dynamic Rotary Filters

Ievgen Mochalin, Suosheng Zheng and Jinyu Liu

Zhejiang Normal University, China

Performance Comparison of Two Guidance Systems for Agricultural Equipment Navigation

Nadia Delavarpour[1], Sulaymon Eshkabilov[1], Thomas Bon[1], John Nowatzki[1] and Sreekla Bajwa[2]

[1] North Dakota State University, United States of America

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Mathematical Modeling of Operating Process and Technological Features for Designing the Vortex Type Liquid-Vapor Jet Apparatus

Yurii Merzlyakov, Ivan Pavlenko, Oleg Chekh, Serhii Sharapov and Vitalii Ivanov

Sumy State University, Ukraine

The Wall Erosion in a Vortex Chamber Supercharger due to Pumping Abrasive Mediums

Andrii Rogovyi[1], Sergey Khovanskyy[2], Irina Grechka[3] and Jan Pitel[4]

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Signal Processing and Conditioning Tools and Methods for Road Profile Assessment

Abduvokhid Yunusov[1], Davron Riskaliev[1], Nurmukhammad Abdukarimov[2] and Sulaymon Eshkabilov[3]

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Optimization of the Multi-Engine Hydraulic Drives Work for Synchronous Movement of the Working Tools in the Machines

Oleksii Havrylenko, Sergii Kulinich

Sumy State University, Ukraine

11^{00}–11^{20} **Coffee Break**

11^{20}–13^{00} Session 11 – Manufacturing Engineering VI

Chair: Oleg Zabolotnyi,
Sumy State University, Ukraine

Development of a System for Supporting Industrial Management

Susana Martins, Maria Leonilde Rocha Varela and Jose Machado
University of Minho, Portugal

Investigation of Properties of Mg and Al based Nano Hybrid-metallic Composites Processed through Liquid
Processing Technique

Shubham Sharma[1], Mandeep Singh[2], N.Jayaram-Babu[3], Kalagadda Venkateswara Rao[3] and Jujhar Singh[4]
[1] CSIR-Central Leather Research Institute, India
[2] University of Technology Sydney, Australia
[3] Centre for Nanoscience and Technology, India
[4] IK Gujral Punjab Technical University, Indi

Modeling of Processes for Creation New Porous Permeable Materials with Adjustable Properties

Oleksandr Povstyanoy[1], Oleg Zabolotnyi[1], Victor Rud[1], Andriy Kuzmov[2] and Halyna Herasymchuk[1]
[1] Lutsk National Technical University, Ukraine
[2] Institute of Problems of Materials Science named after IM Frantsevych of the National Academy of Sciences of Ukraine, Ukraine

Optimal Parameters of Q&P Heat Treatment for High-Si Steels found by Modeling Based on «Constrained Paraequilibrium» Concept

Vadim Zurnadzhy[1], Natalia Zaichuk[2], Aleksander Sergeev[1], Yuliia Chabak[1] and Vasily Efremenko[1]
[1] Priazovskyi State Technical University, Ukraine
[2] Lutsk National Technical University, Ukraine

Programs to Boost IT-readiness of the Machine-Building Enterprises

Bohdan Haidabrus[1], Eugen Druzhinin[2], Mattias Elg[3], Martin Jason[3] and Janis Grabis[4]
[1] Sumy State University, Ukraine
[2] National Aerospace University “Kharkiv Aviation Institute”, Ukraine
[3] Linköping University, Sweden
[4] Riga Technical University, Latvia

Preventive Maintenance System in a Company from the Printing Industry

Marta Szczepaniak and Justyna Trojanowska
Poznan University of Technology, Poland

$13^{00} – 13^{30}$ **Closing Ceremony, Awards and Farewell**

Keynote Speakers

José Machado, Ph.D., Professor
Deputy Director of MEtRICs Research Center,
University of Minho, Portugal

Jose Machado received his PhD degree in Mechanical Engineering – Automation, from University of Minho, Portugal and, in simultaneous, from Ecole Normale Superieure de Cachan, France, in 2006. He is Deputy Director of MEtRICs Research Center and Assistant Professor at Mechanical Engineering department of University of Minho. He has authored, or co-authored, more than 220 refereed journal and conference proceeding papers. He has coordinated – and participated as collaborator in several Research and Technology Transfer Projects on Mechatronics and Automation domains and his main interests are related with Industry 4.0; design and analysis of dependable controllers for obtaining dependable mechatronic systems; and mechatronic systems design with special focus on medical or biomedical applications and/or rehabilitation. He is member of IEEE and member of IFAC.

Keynote Speech Topic

Mechatronic Medical Assistive Devices – Paradigms on Design Tasks Considering Final Purposes

According to the World Health Organization, WHO, there is a significant population sample aged between 65 and 95 years old. Moreover, it claims that the aged world population results from the low birth rate. Ageing is a universal, complex and biological process. These facts make elderlies the most vulnerable group, generally with critical clinical conditions. They need a major concern from healthcare services due to their physical and mental limitations.

Nowadays, in developed countries, this kind of healthcare is not limited to the institutional associations/centers. There is an increase on the availability of medical devices that can be used at home, diminishing the constant need for health professional assistance. The main objective of the assistive technology is to protect and take care of fragile elders. For example, when adapting a bathroom, it must be considered the grab bar tubes to increase mobility and safety. Providing accesses to a walk-in or wheel chair accessible shower is ideal for people with bath disability. There is a permanent demand to improve healthcare, allowing careful and uninterrupted means for the patient mobility. While transferring a patient, it is mandatory to consider the personal needs, maintaining comfort and safety conditions. It should be taken into account that the care issues, in domestic environments, are usually performed by family. Mainly, these patients are being cared by one single person (usually the wife/husband of the impaired patient).

In this context, a wide range of devices has been developed by different research teams and companies. At University of Minho, Portugal, there is a research group developing, together with partner companies, some mechatronic devices in this context, mainly related with Medical Assistance, Mobility and Hygiene. Other devices, on the domains of Safety and Comfort, are being developed. All those devices are market-oriented and are adapted for being used by one single caregiver. This is a gap found in similar mechatronic medical assistive devices, developed by other research teams and companies, where the issue “one caregiver” is not considered.

This talk discusses the mentioned context, proposes solutions and presents some results obtained on the design of mechatronic devices successfully developed at University of Minho - oriented for being used by a single caregiver - and tested in real-environment. Some of those devices are being industrialized for commercialization in the related market.

Justyna Trojanowska, Ph.D.
Faculty of Mechanical Engineering and Management
Poznan University of Technology, Poland

In October 2017, Justyna Trojanowska completed her Ph.D. thesis titled "Methodology of multi-rule production flow scheduling in a production system with an identified critical resource" and become a Doctor of Engineering in mechanical engineering with a production planning specialty. Her research interests cover the areas of mechanical engineering, production management and production scheduling. Justyna Trojanowska has managed and taken part in a number of research projects co-financed by the European Union, and the Ministry of Science and Higher Education and the National Centre for Research and Development, both in Poland. She has participated in projects related to the improvement of production processes in some of the largest Polish companies in the mechanical engineering, automotive and medical industries. She is an author of numerous publications in the field of production engineering and co-author of a book titled "Logistics management in manufacturing companies" and co-editor of a book titled "Advances in Design, Simulation and Manufacturing" published by Springer in the Lecture Notes in Mechanical Engineering series. Moreover, she is a reviewer of scientific articles published in Master Journals. She is a member of program committees of many international conferences, an organizer of many special sessions in the areas of improving manufacturing processes, decision support systems, collaborative manufacturing, and Industry 4.0, at recognized international conferences. Justyna Trojanowska conducts organizational activities. She is a member of Polish Association for Production Management and Polish Economic Society. In 2010, she founded a student research group at Poznan University of Technology, where she continues to serve as scientific supervisor. Since 2016 she has managed postgraduate studies titled "Organization and Production Management". Her organizational activity was recognized in 2013 and 2018 when she received the Poznan University of Technology rector's award for organizational achievements.

Keynote speech topic

Smooth and Economic Production for Everyone

In the face of increasing demand for cardboard packages, proper organisation of production to facilitate rapid response to changing customer requirements has become of utmost importance. The key issue is to maximise equipment uptime and prevent unexpected breakdowns which may halt the production and cause delivery delays which generate delays further in the supply chain. Proper asset management can be supported through the implementation of the Total Productive Maintenance system. This paper presents an original Total Productive Maintenance system developed for a company operating in the packaging industry. The designed documentation and organisation of information flow among the company units aimed at supporting of the TPM system are presented and analysed. The importance of the human factor for the success of the implementation is highlighted, and certain setbacks which may be experienced during the implementation are listed.

Dragan Perakovic
Department of Information and Communication Traffic
University of Zagreb, Croatia

Prof. Dragan Peraković. Ph.D. graduated and completed his Master's degree and Ph.D. (doctoral dissertation title: 'The Model of Information Distribution to Traffic System Users') from the Faculty of Transport and Traffic Sciences (FPZ) at the University of Zagreb. Post graduation, he began his career at the FPZ where he currently holds the positions of Head of Department for Information and Communication Traffic and Head of Chair of Information Communication Systems and Services Management. He has engaged in several international scientific projects and R&D studies as a researcher, leading researcher and evaluator (CiViTAS ELAN, Harmonized Inland Navigation Transport Through Education and Information Technology – HINT, Green Intermodal Freight Transport – GIFT, etc.). He was the initiator and leading researcher for many important national projects such as the Research of the Context of the use of Smartphones and Related Information and Communication Services, Research of Possibilities on Applying the IoT Concept to Improve the Safety Movement of Blind and Visually Impaired Persons along the Traffic Network, Information and Communication Services for the Movement along the Traffic Network by the Persons of Reduced and Difficult Mobility, etc. He is an author/co-author of more than 120 science papers (including three CC indexed papers) and studies presented in journals and proceedings of international conferences, and 11 chapters in international scientific books. He also participated in educational activities within the Faculty, as a lecturer and mentor for undergraduate and graduate study programs. Until now, he has been mentoring more than 150 undergraduate and graduate students and 4 postgraduate doctoral students. Prof. Dragan Peraković is a member of many journals and conferences of his profession, such as International Telecommunications Society (ITS), International Telecommunication Union (ITU), IEEE Communications Society, European Alliance for Innovation (EAI), DAAAM International, The Society of Digital Information and Wireless Communications (SDIWC), Scientific Council for Traffic of Croatian Academy of Sciences and Arts (HAZU) and the Croatian Chamber of Traffic and Transport Technologies (HKITPT), etc. Prof. Dragan Peraković, Ph.D. is editor-in-chief of the International Journal of Cyber-Security and Digital Forensics (IJCSDF).

Keynote speech topic

Challenges and Issues of ICT in Industry 4.0

Information and communication technology continue to positively im-pact on many stages of manufacturing environment. Intelligence is about to be shared from the start to the end of the supply chain. Internet of Things (IoT) is adding intelligence to endpoints, big data are becoming the new way of running a business and Cloud Computing (CC) is becoming a new data center. The ad-vancement that technology brings to manufacturing are fundamentally changing individual companies and transforming market dynamics. Fourth industrial rev-olution (Industry 4.0) is all about including contemporary technologies for pro-cesses of automation and data real-time exchange in manufacturing organiza-tions. This paper represents the basis for designing the communication layer of the ecosystem's value chain depending on the usage scenario within the Industry 4.0 concept. Also, depending on the usage scenario, different service classes are grouped and coverage of the currently available communication networks in the Republic of Croatia is shown. Characteristics and capabilities of Industry 4.0 of-fer efficient business in the fields of logistics, manufacturing, tourism and smart cities. Also, with increased connectivity it is possible to build smarter supply chains, processes and end-to-end ecosystems..

Volodymyr Zavialov

Professor of the Department of Processes and Apparatus

National University of Food Technologies, Ukraine

Volodymyr Zavialov received a diploma of engineer-mechanic (1979) at the Kyiv Technological Institute of Food Industry, then worked as an engineer at the Research Institute of Alcohol and Liquor Industry, as a master workshop at the Experimental Repair Plant. From 1982 to 1985 he studied at postgraduate studies, defended his Ph.D. thesis in 1988. From 1985 to 1990, he worked as an assistant, associate professor, and from 2011 to this time as a professor at the Department of Processes and Apparatus of Food Production NUFT. He performed organizational work as a scientific secretary of the doctoral specialized scientific council on the specialty "Processes and equipment of food, microbiological and pharmaceutical manufactures" (1995-2008), and today he is deputy chairman of the same council; deputy Vice-Rector for Scientific Research, Head of Research Department of the University and Head of the Department of Processes and Apparatus for Food Production (2004-2017). In 2014, he defended his doctoral dissertation on the topic "Scientific substantiation and apparatus design of the process of vibroextraction in food industry". His scientific interests include the study of the laws of intensification of technological processes in apparatus of increased productivity with the use of low-frequency mechanical oscillations. Also, the features of hydrodynamics and mass transfer at all scale levels in the solid-liquid system in relation to extraction tasks from plant raw materials. He headed a number of state-funded projects within the framework of the problem research laboratory of NUFT. According to the results of scientific work published in professional journals about 250 works, is the co-author of 35 author's certificates and patents for inventions, four tutorials, 26 methodological developments. Under his supervision three candidate theses were defended. Member of editorial boards of scientific and technical journals "Scientific Works of NUFT", "Vibration in Technology and Technologies" (Vinnitsa), "Meridian" (Chisinau, Republic of Moldova). He was awarded with the honorary breastplates "Excellence in Education of Ukraine" (2007) and "Petro Mohyla" (2009), received the certificate of appreciation from Prime Minister of Ukraine (2009).

Keynote Speech Topic

Regularities of Solid-Phase Continuous Vibration Extraction and Prospects for Its Industrial Use

With all the diversity of modern extraction technologies for a solid body – a liquid systems with a small difference in the density of the phases, both in chemical and food industries, there are general defects due to the lack of porosity of fine-fraction raw materials for reverse flow continuous extraction and phase separation. For the most energy- and material-intensive branches of food industry, such as sugar, fat, canning, wine-making, brewing, alcoholic, starch-maltodextrin, pharmaceutical, these problems are especially relevant. For these purposes, vibration extractors are the most promising ones, which provide intense interphase mass transfer in the process of extracting with a significant shredding of raw materials of its waste. Vibroextraction is a relatively new technological process. Until now, remained unexplained the definition of the peculiarities of the physical nature of the action of oscillations at the stage of their generation and distribution in the working volume of the apparatus and the mass transfer at different scale levels in system of a solid – a liquid with a small difference in the density of phases. This process implements a new principle of reverse flow phase separation with the help of vibrotransport devices of a special design, which do not cause the pressing of the layer of raw materials and ensure its porosity, regardless of the size of particles. Turbulent pulsating jets generated by the transport elements of the vibration nozzles form optimal hydrodynamic conditions for intensive micro-mixing and, as a consequence, conditions for the creation and renewal of a large interphase surface in cross-sections of the two-phase flow in the entire working volume of the apparatus. Technological and economic characteristics of periodic and continuous vibration extractors developed at the Department of Processes and Apparatuses of NUFT make them competitive. The development can be implemented in the processing industries for providing non-waste and in-depth processing of plant raw materials.

Michal Balog

Department of Industrial Engineering and Informatics

Technical University of Kosice

Associate professor Michal Balog, CSc. large part of his life devotes building the business community. Under his leadership, the transformation of the Slovak Railways and Slovak Bus Transport was realized. As Chairman of the Board of Directors and State Secretary of the Ministry of Transport of the Slovak Republic, he began to pay attention to modernization and informatization of rail transport, which resulted in real projects after the transition to the Technical University in Košice. He is currently the EU H2020 Less than Wagon Load project researcher as well. In the context of disseminating informatization into practical life, he is also a researcher of the EUREKA project, which is focused on informatization of health care. He has published 28 publications, with 71 citations in significant database Web of Science and in Scopus it has been 20 publications and 29 citations and other journals and conferences. He is the co-author of 2 patents and 3 utility models registered at the Industrial Property Office of the Slovak Republic. Since 2014, he has been chairman of the Organizing Committee and chairman of MMS conferences - International Conference on Management of Manufacturing, which is dedicated to theories and the transfer of knowledge into practical life. He is also a member of the European Alliance for Innovation (EAI) and in 2019 he received the Fellow title. In the pedagogical area, he covers the study program Production Management in 1st and 2nd degree and the lectures on subjects such as Crisis Management, Information Systems in Manufacturing Company, Electrical and Electronics, and Distribution Logistics and Supply. From the beginning of his work at the Faculty of Manufacturing Technologies in Prešov, he has led 45 theses, 24 bachelor theses and 3 defended dissertations. He currently supervises 3 Ph.D. students.

Keynote Speech Topic

Introduction of Modular Charging Stations Based on IoT with the Possibility of Implementation to Automotive Industry

The worldwide electric vehicle market is developing steadily and gradually becoming a worthy alternative to fuel cars. Nowadays, there are numerous reasons to use this type of transport. The annual growth in demand for electric transport has led to the expansion of the supply of this type of transport by various manufacturers. Each manufacturer strives to offer its unique product, which begotten arise of different types of charging connectors, different types of batteries, as well as various types of the whole car system. The growth of sales of hybrid and electric vehicles facilitated the importance of creating an appropriate charging station. Despite the existing number of charging stations, the number of problems was determined, such as the lack of charging stations with the necessary connectors, shortage of stations on highways, non-contiguous work of the charging stations. From an analysis of the market characteristics, arises the ability to design the charging station, which will fulfil all requires of the customers and European government. Research results became a ground of the proposed charging station.
The modular hybrid charging stations (MHCS) includes an electronic control unit, parking scanner, storage battery, solar panel, some types of connectors. MHCS will be powered by several energy sources, to produce fast charging and normal charging. The battery will be charged by a solar panel and by the electricity grid, which will help provide continuous work of the station. Saving time was solved by the implementation of a scanner, which will indicate reserving of parking/charging place by two colours. Also were proposed using the maps, ECU (Electrical Control Unit) and self-diagnostic sensors, all this will allow monitoring reservation of charging place and workability of the station in real time. Such types of the charging station will wide user's number of electric vehicles, to stimulate active using of green energy, to support the idea of a green environment. The introduction of this charging station will satisfy the needs of not only electric transport users but helps to occupy a favourable position for manufacturers of charging stations.

Grigore Marian Pop
Department of Engineering Design and Robotics
Technical University of Cluj-Napoca, Romania

Grigore Pop is a lecturer in the Department of Engineering Design and Robotics from the Technical University of Cluj-Napoca with a BSc in Machine Building Technology, a post graduate degree in Unconventional Technologies, in German Language, and a PhD in Industrial Engineering. His research interests cover the area of measurements, quality assurance manufacturing and production. In the pedagogical field, he lectures the subjects Geometrical Product Specification, Basic Metrology, Tolerances and Dimensional Control and Quality Management. He also has an ongoing cooperation with Bielomatik Romania S.R.L, where he is working as the Quality Manager for over 4 years. He has been involved in educational process of different universities as invited professor: Sumy State University, Ukraine; Institute of Manufacturing Science, Miskolc, Hungary; Poznan University of Technology, Poland; Vienna University of Technology, Austria; University of Žilina, Slovak Repubic. Research activities: Project management: Researches regarding the machining of advanced materials such as carbon fiber reinforced composites, Strategic Themes Research for young teams, type 1.2, contract no. 29545/9.12.14. Project leader in contracts with the industry: Metrology courses, S.C. Emerson S.R.L and SC European Fabrications SRL. Evaluation and analysis of requirements, functions and characteristics for a concept using Qualica, QFD. Professional recognition and international visibility: Member of the organizing committee ICPR QIEM, QUALITY AND INNOVATION IN ENGINEERING AND MANAGEMENT. Invited researcher – Thermal Behavior during the drilling process of Carbon Fibre Reinforced Composites, Universitaet Stuttgart, Institut fuer Werkzeugmaschinen, Stuttgart, Germany. Regular reviewer for ISI quoted journals: Elsevier Composites part B. Publications: 40 papers in ISI/BDI; 3 books.

Keynote Speech Topic

The Effectiveness of ICT Tools for Engineering Education

The propose of the research is to implement and design of a mobile-learning application to improve the quality of the teaching process of Tolerances And Dimensional Control for engineering degrees (design, robotics, industrial and mechanical engineering). One of the main advantages given by mobile applications is that they are available round the clock, offering a variety of ways to learn, communicate and collaborate. The studies focused on the impact of mobile learning on student achievement show that this method could be one of the promising educational technologies for development in educational environments and the use of mobile devices as tools for education al purposes has a positive effect ISO Checker is available in four different languages, German, English, French and Romanian, offering the main information presented in ISO SYSTEM OF LIMITS AND FITS. Given the current technological innovations, the fact that students are now hi-tech learners, we consider that using mobile applications integrated into the study of Tolerances and dimensional control stimulates student's involvement, considering the positive feedback we had during the first semester of the academic year 2018-2019.

Abstracts
Part I
Manufacturing Engineering

Case Study of Model-Based Definition and Mixed Reality Implementation in Product Lifecycle

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In the new era of Industry 4.0, new strategies and approaches for the use and storage of product and data processing over the entire product life cycle are developed. One of these approaches is Model-Based Enterprise / Definition. This approach attempts to place the relevant information in a single model, avoiding unnecessary interfaces between different tools and documents and redundant data. Another big trend of the recent time in the industry is the use of virtual and mixed reality in different phases of the product life cycle. The images of product geometry and information can be used virtually in the real environment and the design and processes can be validated before the production begins. This research work aims to research the possibility to combine and practically use the both mentioned technologies in the industrial enterprise processes for certain phases in the product life cycle. The present work examines the possibilities of integrating the advantages of model-based definition into mixed reality and making them usable for business processes. The proposed approach was validated for the valve quality assurance process at Siemens P&G.

Keywords: Quality Assurance, Model-Based Development, Authorized Model Design.

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Design Optimization Techniques in Mechanical Design and Education of Engineers

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With each year computerized tools for mechanical design become more comprehensive and contain a great variety of tools for engineers. Using the tools as black box solutions contains a lot of risks. In the field of CAD/CAE in mechanical design one of the hot topics is the optimization of the shape of a structure complying to certain boundary conditions to make a structure lighter and thus more economic. Although these techniques have been described a long time ago, through to recent developments in additive manufacturing and other prototyping techniques which make it possible to make the resulting structures, the tools are currently gaining a lot of importance and are being implemented. In the article we consider a case study to show the differences between topological and parametrical optimization for the same task. Based on this example the authors would like to stress the importance of the correct implementation of these two approaches and the importance of teaching the methodology and not only tools in the engineering study.

Keywords: CAD/CAE, Parametric Optimization, Topology Optimization.

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DOI: 10.1007/978-3-030-22365-6_2

Prospects of the Implementation of Modular Charging Stations Based on IoT to the Infrastructure of the Automotive Industry

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The article is focused on the investigation of the modular hybrid type of intelligent charging stations and their application in the automotive market infrastructure. A study of this market has shown that customer requirements are not fully satisfied. Besides, the current market state of charging stations requires the best service to be provided to its customers. The importance of supporting demand on such vehicles is caused by the current state of ecology in the world. The performed analysis has revealed an insufficient level of providing the market with the necessary infrastructure, in particular, the lack of a sufficient number of charging stations for electric vehicles, especially in the European market. The evaluation of the activity of the main suppliers of charging stations in the world market was carried out in order to find the best solution. According to the analysis, it was proposed to introduce the modular hybrid charging station that allows to extend the demand for electrical vehicles (EV) and to satisfy the expectations of manufacturers and customers. The strength of the proposed device is to integrate existing advanced technologies in order to create a completely new product that corresponds to the trends of Industry 4.0.

Keywords: Charging Stations, Automotive Industry, Electric Vehicles, Ecology of Transport.

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DOI: 10.1007/978-3-030-22365-6_3

Creative, Quality Oriented Rethinking of the Assessment Strategy at the University Level Courses. A Case Study

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One of the main success factors of higher education institutions (but not the only one) is the constant focus on the quality and the continuous improvement of the teaching and learning evaluation process. Orientation towards the innovation, increased attention to the needs and interests of the education customers and stakeholders becomes imperative when universities want to become or remain competitive on the education services market. In this respect, the real involvement of students in their dual quality as internal and external clients in improving the quality of the educational process by considering their opinions and suggestions is proof of the student-centered education and contributes to the motivation and the increase of their satisfaction. This paper represents just a sequence of a more extensive program of the course redesign, carried out at one of the Master's degree programs from the Technical University of Cluj-Napoca, focusing exclusively on the evaluation aspects. The process of the course redesigning was focused on both teaching and learning processes and followed a series of steps, according to a model previously promoted by the author, using a number of innovative methods and tools for each stage.

Keywords: Educational Process, Evaluation Strategy, Continuous Quality Improvement, Innovation.

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DOI: 10.1007/978-3-030-22365-6_4

Numerical Deflections Analysis of Variable Low Stiffness of Thin-Walled Parts during Milling

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The milling of parts with variable low stiffness requires consideration of a number of factors that are an obstacle to achieving technological requirements for the product. One of the most important factors of geometrical deviations in the milling process is the elastic deformation of the thin-walled parts. The review of prevention methods of undesirable deviations occurrence in the machining process of the variable stiffness parts is made. A detailed preliminary analysis with the help of engineering automation is proposed as a technological solution for the milling of thin-walled parts with a complex geometry. The forces that occurs during the material removal are calculated, directional force that acts on the face surface of the thin-walled element is defined. The dynamic process of material removing is modeled. The critical points of the thin-walled variable sample in deflections model are defined. The forces in the removal zone have been processed and included in the deflections model. Comparison between oscillation amplitudes in the process of conventional and high speed machining is made.

Keywords: Variable Stiffness, Elastic Deformation, Thin-Walled Parts, Process model, Undesirable Deflections, High-Speed Machining.

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Modeling of Mixing Bulk Materials

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Based on the analysis of the mixing methods of bulk materials and mixer designs, the method of continuous mixing of bulk materials and the design of a spiral mixer for the implementation of the method is substantiated. The method involves the formation of a multi-layer flow of components in the desired ratio, with subsequent separation of the flow into portions of a small volume and mixing the components in a portion. After that, the mixing of portions of the finished mixture is carried out. The development of a new mixing method is due to the fact that known methods not providing a uniform distribution of components in the volume of the mixture are time-consuming and energy-intensive. Modeling different ways of mixing dragees has proved the effectiveness of the developed mixing method. Experimenthas determined values of qualitative indicators of dragee mixes, in particular, the average contents of sweets of different colors of the mixture and the value of the heterogeneity of the mixture. Mixing of bulk materials in the developed way ensures uniform distribution of them in volume of mixture. Theoretical dependences are obtained for substantiation of rational structural and technological parameters of the equipment implementing the proposed method. It has been established that, in addition to improving the quality of the mixture, the developed method and the spiral mixer provide a reduction in the duration of the mixing process, do not cause damage to the components of the mixture and reduce the energy consumption for mixing process.

Keywords: Mixing Method, Loose Material, Mix Quality, Mixer.

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DOI: 10.1007/978-3-030-22365-6_6

Information Support for the Quality Management System Assessment of Engineering Enterprises

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In the current conditions of production activities, more enterprises are working on the development and implementation of process-oriented management systems that correspond with international standards for management systems. The main purpose of the implementation of such systems is the satisfaction of the requirements of various stakeholders, and the index of their satisfaction becomes the criterion of perfection of the enterprise. Therefore, the task of its quantitative assessment is topical. In the paper for the determination of generalized satisfaction index of stakeholders, on the basis of fuzzy sets theory a scale of values of the linguistic variable "Satisfaction" was developed. This approach allows to assess the compliance degree of stakeholders' requirements and to present it as a linguistic value for further determination of the directions of improving the quality of the enterprise processes. On the basis of the principles of creating an information system for an engineering enterprise, the paper proposes the information support for the process of quality management system assessment, the main task of which is to create conditions that ensure rational processing and timely provision of necessary information on the functioning assessment results of the system that are under consideration. In the development of information support, the paper takes into account the possibility of using it as one of the blocks of a single information system of the enterprise, which makes it possible to create an information databank, as well as carry out a comparative analysis of the indexes under consideration for any period of time.

Keywords: Interested Party, Satisfaction, Assessment, Scale, Method, Theory of Fuzzy Sets, Linguistic Variable.

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Programs to Boost IT-readiness of the Machine Building Enterprises

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One of the important aspects of providing the high level of the enterprises competitiveness on the market is existence of the necessary level of IT-readiness. By using the term "IT-readiness" we mean the ability of the enterprise to reach the mission by the most effective use of modern information technologies. There are contradictions between the need of the enterprise operatively to reconstruct design and production structures accordingly to the market condition change and the level of the modern IT use for maintenance of science intensive samples creation projects. The problem situation becomes complicated because of the lack of possibility of the fast development of expensive information support systems through the absence of big financial resources for the machine building enterprises in the conditions of an unstable investment climate and a low level of profitability. It leads to the need of the stage-by-stage IT introduction in the course of a life cycle support of a new equipment creation project that is also a characteristic for the machine building enterprises. It turned out that the high technology development is carried out now under the conditions of essential restrictions of financial resources all around the world. In these conditions one of progressive ideologies is Lean Manufacturing methodology.

Keywords: CMMI, Organization Structure, Automated Control System Supports, Types of Providing.

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Finite-Element Model of Bimetal Billet Strain Obtaining Box-Shaped Parts by Means of Drawing

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The articke shows data on determining billet shape while obtaining a box-shaped part from aluminum-copper bimetallic composition. Special attention in the course of finite-element modeling of strain process is paid to the choice of mechanical characteristics of each layer and the nature of the relationship between layers. It is shown that the optimal billet shape for drawing is a “rectangle with cut angles” and copper layer outer position. This billet shape ensures the absence of corrugations with a single junction drawing of aluminum-copper bimetal box-shaped parts, and also provides the least deformation force with minimum intensity of stresses and strains. The absence of folds allows to judge on sufficiently proportionate layer-by-layer strain and preservation of the indissoluble layer-by-layer engagement. This makes possible to design a technological process for the production of bimetallic contacts with the required set of electromechanical characteristics and to recommend it for manufacturing. It is also noted that a more solid and consistent material for obtaining the optimum product handling properties should be located on the outer layer of the part. The presence of lamination in a bimetallic composition increases the electrical resistance hundredfold and leads to the product rejection.

Keywords: Layered Metals, Drawing, Box-Shaped Parts.

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Estimation of Temperature Levels in the Area of Polishing with Polymer-Abrasive Brushes

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A technique for measuring and monitoring the temperature in the area of processing with polymer-abrasive (PA) brush tools of rotary action, which have thermal performance limitations due to the low melting temperature of the fiber polymer base, is proposed. Therefore, experimental thermal studies directly in the "brush-sample" contact zone are relevant. It is important for maintaining high tool-life of brush PA tools. The temperature in the processing zone is influenced by the polishing modes (feed, tension, speed), tool parameters (diameter and length of fibers, which characterize the brush stiffness). It was found that the temperatures measured during processing without lubricant-cooling agents were 30...130°C depending on modes and brush rigidity. The dependence of the maximum temperatures in the "contact patch" on the modes and parameters of the tool when polishing with brushes of various materials was established. Most PA brushes have a thermal limit of 100...120 °C. Most polishing work can be done without lubricant-cooling agents. However, to work on "hard" modes or on materials with low thermal conductivity it is necessary to apply lubricant-cooling agents or brushes with high thermal resistance of fibers (200 °C); such brushes have recently appeared on the market of tools for finishing operations.

Keywords: Finishing, Brush Tools Based on Polymer-abrasive Fibers, Thermal Limitations, Temperature in Working Area, Artificial Thermocouple.

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Analysis of the Involute and Sinusoidal Gears by the Operating Parameters and a New Method of Its Cutting

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Today, involute spur gears are the most common in mechanical engineering. However, besides of the benefits, involute teeth present several disadvantages. To overcome those disadvantages, designers resort to changes that increase the complexity of equipment, cutting tools that lead to the expensive cost. On another hand, gear and transmission, namely sinusoidal gear and transmission is known by higher properties. The results of the simulation of involute and sinusoidal gearing are described in the article. Proved that, sinusoidal gears have higher performance parameters. Simulation confirmed that sinusoidal gear have higher bending strength, lower contact stress, reduced contact friction and tension in the edging contact, improved performance indicators of transmission. The advantages are due to the following features of the sinusoidal gears geometry: gear tooth profile outlined by a smooth sine wave curve; greater teeth thickness on the pitch circle; wide range of coast flank pressure angle. A new method of gears machining is described. This technology makes it possible to reduce number of expensive and complex gears cutting tools and gears machine tools, greatly simplifies technology of tooth cutting and reduces the cost of gears manufacturing by a numerous times. The method has a wide versatility, provides the opportunity to produce a variety of gears types including, gears with asymmetric teeth.

Keywords: Sinusoidal Gears Advantages, Cutting Forces, Load Capacity Research, Reliability, Stress Simulation, Strain, Tension.

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Technological Assurance and Features of Fork-Type Parts Machining

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To provide the machining accuracy of parts on metal-cutting machine-tools fixtures appointed for accurately locating and reliable workpiece clamping are used. The expansion of technological capabilities of modern CNC machine tools necessitates the improvement of design procedures in production planning is needed. The variety of parts and the tendency to increase their complexity, as well as the desire to reduce the cost of time, makes it necessary to find new approaches to the design of tooling. The article proposes the design of a flexible fixture, which provides sufficient tool availability and allows multiaxis machining of fork-type parts at one setup. The ways of intensification and manufacturing process of fork-type parts machining with a significant reduction of auxiliary and preparatory time are offered. Studies performed by numerical simulation methods confirmed that the proposed design meets all the accuracy parameters. The results of static structural, modal, and harmonic analyses confirmed that the proposed fixture had sufficient strength and dynamic stiffness, which allows it to be used with intensive cutting modes that are characteristic of modern machines and cutting tools. The oscillation amplitudes in places of the work surfaces in the proposed device do not exceed the tolerances for the manufacturing of these surfaces.

Keywords: Flexible Fixture, Manufacturing Process, Numerical Simulation, Stiffness, Accuracy.

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Increasing the Efficiency of the Production Process due to Using Methods of Industrial Engineering

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The thesis deals with the increase of production productivity using industrial engineering methods. Application of lean methods in production process and logistics. (predicate should be added). In the theoretical part of this thesis the knowledge (information in this case is better) drawn from technical literature in the field of industrial engineering is presented. In particular the problem of balancing the production line is described here. The right production cycle is a basic requirement for serial production. Process analysis and the right detail analysis of production operations is the main indicator for batching of the production cycle and the detection of bottlenecks. In the analytical part, an approach to resolving changes on the production line is described. Time analysis of layout changes and decision analysis are described. Narrow spots have been removed by various principles. There has been a change in the layout of the production line and the application of new technology in the control room. The entire study shows the practical verification of the acquired knowledge in the field of industrial engineering and subsequent application in real operation. The project was built on the REFA methodology that was important for balancing manufacturing operations. In order to achieve the optimum production cycle, the layout had to be changed. The new layout contained a decision analysis to determine the right solution. The whole study shows a systematic approach to applying the above methods.

Keywords: Operation, Balancing, Layout, Production Cycle, Analysis, Logistics, Improvement.

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Recruitment Web-Service Management System Using Competence-Based Approach for Manufacturing Enterprises

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Today there are many different web services for employment, but only a few of them have a focus on IT professionals for manufacturing enterprises. There is a need to select applicants with the required competencies with minimal time expenditures. The goal of the paper is to develop the architecture of a web service for the recruitment of employees at enterprises using a competent approach according to the international standards of eCF. In present there is no analogue of our recruitment web-service management system using competency-based approach for both manufacturing enterprises and employees. We prepared review and analysis the existing analogues of web-based job placement services, functional and non-functional requirements for web-based job placement for enterprises using competency approach. The high-level architecture and technical tasks for the participants of our web-based job placement service were also developed and described in our research. Data analysis of employers' requirements was prepared for decision making of employee of manufacturing enterprises through software package.

Keywords: Enterprises, Recruitment Web-Service, Competences, ICT for Education.

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The Application of the Uncorrected Tool with a Negative Rake Angle for Tapered Thread Turning

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Based on geometric modeling and FEM, it is developed a technique for choosing the values of geometrical parameters of a threaded turning tool (rake angle, clearance angle, inclination angle of the cutting edge). This technique depends on the allowable values of kinematic rake and clearance angles at different points of the cutting edge and reliable characteristics of the threaded connection - fatigue strength and contact pressure in the thread. Using this technique, it is reasonable to use tools with an uncorrected profile and a negative value of the static rake angle at the nose point -10 ° for turning the pin thread of the tubing with a diameter of 114 mm, which is made of difficult-to-machine steel. The calculated values of the kinematic rake angles (-4.4°..-5.5°) indicate improved cutting conditions. Fatigue strength of the threaded connection almost does not change, but in order to avoid gaps in the connection, the coupling thread must be made by taking into account the difference in the flank angles of the pin and coupling.

Keywords: Turning Threading Tool, Rake Angle, Threaded Connection, Drilling Tool Joint, Tubing, Geometric Model, Finite Element Model.

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Simulation of Induction Heating for Railway Wheel Set Elements During Assembly and Disassembly

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Induction heating process during wheel assembly, as well as the heater design during railway wheel set axle equipment disassembly, are suggested. Simulation of railway wheel thermal elasticity is carried out in SolidWorks Simulation. Deformation processes at local induction heating are fast and affect the obtained joint dimensions. The obtained data make it possible to set the time and dimensional parameters of the assembly technological process. The design of an induction heating unit for axle equipment elements removal is proposed. In the view of workability, the inductors with cylindrical encircling coil made of a solid copper conductor or copper tube are considered the best. In order to make heating the most effective, the inner surface of coil must be as close as possible to the heated surface. At the same time, the heater moves freely upon the part. , It is necessary to use inductors with magnetically conductive system to decrease the dispersion of the magnetic field in the air and to enrich its concentration in the part material. The part or the parts group being heated is an element of inductor magnetic system. It is recommended to perform heating of the whole package simultaneously – two bearing rings and a labyrinth sealing – to increase the process capacity of induction heating unit.

Keywords: Joints with Interference, Thermal Induction Heating, Railway Wheel Set, Assembly Simulation, Thermal Deformation, Nonstationary Mode.

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Investigation of the Dynamic State of Adjustable Milling Heads

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The problem of improvements in machining large dimension flat surfaces of width 400 mm and closed ones, which are under the presence of engaging step on the sides, of unfinished workpieces productivity is considered. It is proposed to use milling heads with adjusting the milling width for the mentioned surfaces machining. A variant of the mill design has been developed, where the spindle block containing two face mills with intersecting cutter trajectories can be rotated by an angle in the range of 0° – 360°. The dynamic characteristics studies into dedicated CMH with adjusting the milling width have been conducted. It has been established based on the three-mass dynamic model of the mill that rigidity changes in the feed plane even by 10 % leads to a change in the main semi-axis of the ellipse of the movement trajectory along the yi axis, while the change in the second axis can be considered as insignificant (up to 3 %). It has been established that the proper selection of the mills' system resulting rigidity can achieve tool operation stability and accuracy in size and geometry of the workpiece surface based on the study of the design of dynamic characteristics.

Keywords: Milling Head, Wide Flat Surfaces, Milling, Dynamic Characteristics.

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Experimental and Analytical Study of CBN Grinding of Welded Martensitic Aging Steel

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Martensitic aging steels (Marging steels -MS) are high-alloyed low-carbon (0.03% C) structural steels based on the Fe – Ni and Fe – Cr – Ni systems, additionally doped with cobalt, molybdenumtitaniumetc. The article presents the results of studying of the grinding process of martensitic aging steels. The physical nature of the transformations occurring in the surface layer of the grinded surface under the influence of the contact grinding temperature is considered. The steels are heated for hardening up to temperatures approximately 1200 ºC. At this temperature, the intermetallic compounds of the alloying elements (usually fine and solid) dissolve in the solid solution. With rapid cooling at rates above the critical hardening rates, a decarburized “soft” martensite is formed, in which the intermetallic compounds are dissolved. This is followed by aging at temperatures of about 480 – 5200 C. Under the effect of tempering temperature, the precipitation hardening of steel occurs, which consists in the fact that intermetallic compounds in a finely dispersed state are separated from a solid solution and block dislocation movement, because of which the steel acquires high mechanical properties. Under the action of contact grinding temperature 550-6000 C these properties can be lost. The dependence of the contact temperature on the modes of borazon grinding is shown. The research is aimed at creating a database of permissible grinding conditions, the use of which provides optimal contact temperatures and a defect-free surface layer.

Keywords: Borazon, Contact Grinding Temperature, Martensitic Aging Steel.

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Effects of the Combined Laser-Ultrasonic Surface Hardening Induced Microstructure and Phase State on Mechanical Properties of AISI D2 Tool Steel

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The surface layers of AISI D2 tool steel were hardened by a laser heat treatment (LHT), by an ultrasonic impact treatment (UIT) and by a combined laser-ultrasonic treatment (LHT + UIT). The peculiarities of microstructure and phase formations in the surface layers were analyzed after the above-mentioned surface treatments performed in the optimum regimes. Microstructural changes were studied using an optical and a transmission electron microscopy to corroborate the results of XRD analysis. Based on the experimentally obtained data regarding the grain/subgrain size, the dislocation density, and the volume fraction and size of carbides, the differentiated contributions of various hardening mechanisms to the mechanical characteristics (σ0.2, HV) were theoretically assessed. The results indicated that the contribution of the grain boundary hardening is the most influential one among the hardening mechanisms in the cases of the LHT (~ 47%) and combined LHT + UIT (~ 51%) processes. Conversely, the dislocation hardening (~ 34%) mainly contributes to the UIT induced hardening.

Keywords: Laser Heat Treatment, Ultrasonic Impact Treatment, Surface Layer, Structural Parameters, Hardening Mechanisms, Microhardness, Yield Strength.

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Temperature Field Analysis in Grinding

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The paper is devoted to solving an important scientific problem of determining the profile grinding temperature based on the choice of a not complex but at the same time adequate solution from the available analytical ones. The initial prerequisite for the paper developing concept is that of a moving heat source. In engineering applications, the moving heat source is often represented in the form of a moving contact zone between the grinding wheel and the workpiece surface. The source forms around itself a three-, two- or one-dimensional temperature field in the Cartesian coordinate system with (three- dimensional) and without (two- or one-dimensional) taking into account the influence of the source length in the direction, which is perpendicular to the direction of the source moving, respectively. There is another possibility to simplify the determination of grinding temperature by choosing a one-dimensional solution of the differential equation of heat conduction in which the moving heat source is absent and replaced by the time of action of an unmoving heat source. This time is equal to the ratio of the contact length (in the direction of moving) to the velocity of its movement. Due to the high speeds of the discontinuous profile grinding process, the replacement of the moving source with the unmoving (stationary) one often does not affect the accuracy of determining the profile grinding temperature on the surface and in a thin surface layer.

Keywords: Grinding Wheel, Grinding Temperature, Moving Heat Source.

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Development of a System for Supporting Industrial Management

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Mass customization is the most current production paradigm in organizations that depend heavily on the demands of their customers and with the ambition to stand out from the high competition in the market. However, given the increasing diversity of products that this type of production implies, implementing it in a company involves challenges, mainly in the Product Data Management (PDM). Thus, information technology and systems, more specifically Enterprise Resource Planning (ERP), are other determining factors for the success of organizations, allowing them to be more efficient through the integration of information. In response to a better functioning in the production planning and control (PPC), with the increasing expansion, the company Be Stitch directed the production of textile articles for the home market, and decided to innovate investing in an information system, allowing to adapt the way in which it operates and generates the required PPC information. With the phases of analysis, selection and survey of requirements carried out for the initial phase, the present project appeared as a follow-up to develop a software - Silex - being presented and specified the main functionalities needed, implemented and tested. After being developed and implemented in the company, this software has shown an improvement in the flow of information and is very beneficial in cases where the information is not centered in a certain point, as is the case of Be Stitch, which has streamlined and improved the communication between them.

Keywords: Customization, PDM, ERP.

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Technology Support for Protecting Contacting Surfaces of Half-Coupling – Shaft Press Joints Against Fretting Wear

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The paper describes the problem associated with the destruction occurred because of fretting wear (FW) of contacting surfaces of elastic coupling (EC) parts, among which the most attackable connection is a tension fit joint of half-coupling - shaft type, wherein the shaft outer cylindrical surface makes contact with the half-coupling inner cylindrical surface. The essence of the most known methods for improving the quality of press joints (increasing bearing capacity, raising joint tightness and shaft strength, as well as reducing FW) is in introducing certain intermediate layers between mating surfaces of parts. In contact, those intermediate layers get properties being significantly different from the original ones, i.e., the transferring occur of such a feature as sliding ability into the intermediate medium. As a novelty, to create such layers, it shows the application of the electric spark alloying (ESA) method, as the most promising, eco-friendly and energy-efficient. The paper presents the ESA processes of aluminizing, sulfidizing and carburizing, which simultaneously occur on the internal surfaces of the half-coupling (hub) in the areas of its ends, and make it possible to improve atmospheric corrosion (fretting corrosion) resistance, prevent adhesion between contacting surfaces, improve surface micro hardness and wear resistance, as well as provide for increasing the joint tightness.

Keywords: Aluminizing, Carburizing, Coating, Elastic Coupling, Electrspark Alloying, Half-Coupling - Shaft, Hub, Fretting Wear, Sulfidizing, Tension Fit Joint.

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Numerical Prediction of the Elastic and Strength Properties of Woven Composites

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The article is devoted to the development of the procedure for the numerical determination of effective elastic constants and parameters of the strength criterion of woven composites based on known properties of the matrix and fibers. The mechanical characteristics of carbon plastics were obtained by numerical analysis of the stress-strain state of a representative volume using finite element software package ANSYS. A series of numerical experiments is performed in which a local stress state of a representative volume is modeled under the conditions of a uniform average stress state of an equivalent homogeneous material. Requirements of periodicity are used as boundary conditions. The calculations are performed for tension and compression in two directions, shears in two planes and two tensions simultaneously in two directions. For composites all the parameters of the quadratic strength criterion are determined. The proposed criterion takes into account the orthotropy of the material and the differences in the tension and compression strengths.

Keywords: Woven Composites, Computational Homogenization, Strength.

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Technical-Economic Aspects of the Use of Technological Process of Deforming Broaching

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The article gives a definition of the technical and economic potential of the application of the deforming broaching process. Research of the consequences of introducing deforming broaching into technological processes at manufacturing enterprises is carried out on the basis of application of system resource and matrix approach. On the basis of the performed researches, a methodological basis for the economic evaluation of the results of applying deforming broaching on the production has been developed. The article has improved the well-known scientific and methodological foundations for the determination of technical and economic results of the application of deforming broaching due to the complex identification of production-organizational decisions - in technical and forms of evaluation in economic spheres. The developed approach gives an opportunity to more accurately assess the economic effect of introducing deforming broaching on the mining, metallurgical and machine building industries. It can be used to assess the economic effect of introducing other process parts processing.

Keywords: Deforming Broaching, Economic Effect, Efficiency, Resources, Saving, Products, Restoration, Machining.

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Data Integration Technology of Industrial Information Systems

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Research results on the development of an information support system for data integration from integrated production systems are presented. The way of information systems integration is offered as data integration of information systems of production purposes and data that generate a subsystem of implementing the developed methods for the adoption of optimal design and manufacturing solutions implemented based on a universal PDM system with the help of intermodulation software interface. formal information models of data and methods of maintaining a full life cycle of information that will allow to implement the information support technology for the integration of production data are created. A functional-structural scheme for the implementation of the proposed method is described. The recommendations for practical use in the conditions of operating industrial enterprises are given. Developing this approach, the authors conducted a study on the formalization and modeling of design, production and normative reference data of the machine-building enterprise. Semantic modeling of data is carried out, design procedures for establishing their interconnections are developed.

Keywords: Data Integration, Information Systems, Integrated Production Systems, PDM-systems.

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Challenges and Issues of ICT in Industry 4.0

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Information and communication technology continues to positively impact many stages of the manufacturing environment. Intelligence is about to be shared from the start to the end of the supply chain. Internet of Things (IoT) is adding intelligence to endpoints, big data are becoming the new way of running a business and Cloud Computing (CC) is becoming a new data center. The advancement that this technology brings to manufacturing is fundamentally changing individual companies and transforming market dynamics. The fourth industrial revolution (Industry 4.0) is all about including contemporary technologies for processes of automation and real-time data exchange in manufacturing organizations. This paper represents the basis for designing the communication layer of the ecosystem's value chain depending on the usage scenario within the Industry 4.0 concept. Also, depending on the usage scenario, different service classes are grouped and coverage of the currently available communication networks in the Republic of Croatia is shown. Characteristics and capabilities of Industry 4.0 offer efficient business in the fields of logistics, manufacturing, tourism and smart cities. Also, with increased connectivity it is possible to build smarter supply chains, processes and end-to-end ecosystems.

Keywords: Communication Layer, Smart Factory, Smart Manufacturing, Digital Transformation

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The Effectiveness of ICT Tools for Engineering Education: ISO Checker

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One of the main advantages given by mobile applications are that they are available round the clock, offering a variety of ways of learning, communicating and collaborating. The proposal of the research is the implementation and designing of a mobile-learning application to improve the quality of the teaching process of Tolerances and Dimensional Control for engineering degrees (design, robotics, industrial and mechanical engineering). The studies focused on the impact of mobile learning on student achievement and it showed that this method could be one of the promising educational technologies for development in educational environments. The usage of mobile devices as tools for educational purposes has a positive effect as ISO Checker is available in four different languages, German, English, French and Romanian, it offered the main information which was presented in ISO SYSTEM OF LIMITS AND FITS. Given the current technological innovations, the fact that students are hi-tech learners now, we consider that using of mobile applications integrated into the study of Tolerances and dimensional control stimulates student's involvement, considering the positive feedback which we had during the first semester of the 2018–2019 academic year.

Keywords: Mobile Learning, ISO FIT Calculation, Geometrical Product Specification (GPS), Android Application.

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Improvement of the Technology of Tribostate Application of Powder Paints Using Fractal Analysis of Spray Quality

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The paper proposes a method of quantitative fractal evaluation of the quality of powder materials application on metal surfaces by tribostatic method. Design of tribometry spray, which provides efficient charging of powder with different fineness and moisture content of the particles is developed. The computer implementation of the proposed algorithms for assessing and controlling the quality of powder coating is carried out. Laboratory experiments have shown that with an increase in the number of helical elements in the design of the sprayer, the fractal dimension of the corresponding sample images of spraying spots appeared. The results support the hypothesis that the increase in number of the screw elements leads to increase in the length of the path of the powder in tribospayer. This significantly increases the number of collisions between the individual powder particles and the walls of the spray gun, and it contributes to a stronger charging of particles of different types of powder paints and, as a result, reduces the shedding of powder from experimental samples of different materials. The conducted research can significantly optimize the technological processes of tribostatic spraying of powder paints at small enterprises of machine-building or automotive industry.

Keywords: Sprayer Design, Fractal Dimension, Quantitative Analysis of Spray Quality, Tribostatic Gun.

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Improvement of Manufacturing Technology and Recovery of Clamping Collets for Lathe Automats

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On the basis of theoretical and experimental investigations a new advanced technologies of clamping collets manufacturing are offered. The technology of manufacturing non-adjustable and cast collets as well as the technology of their multiple recoveries have been developed. Using these technologies can increase the durability of the clamping collets for lathe automats by 2 to 5 times with an increasing the coefficient of using the metal from 22-26% to 70-95%. It's possible due to the choice of an optimal geometry of clamping collets, improving the contact conditions of collets with a spindle and rod, improving the structure of metal and reducing the stress concentrators in the places of transition the collet's petals. The research presents the main features, principal casting scheme and the operations sequence of cast clamping collets manufacturing technology. The adaptations and formulas to determine the allowance to re-grinding of working hole are presented, the number of recoveries for grinding the outer cone and inner working hole of clamping collets at its recovery is calculated.

Keywords: Petals Elasticity, Collets Clamping Mechanism, Heat Treatment, Cast Clamping Collets, Wear and Recovery.

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The Study of Surface Microgeometry and Morphology of Plasma Electrolytic Oxidation Dielectric Coatings on Aluminum Alloys

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The article focuses on the results of the surface microgeometry and morphology research of the plasma electrolytic oxidation (PEO) coatings produced in the alkaline-silicate electrolytes in various electricity modes – galvanostatic (GS) and arbitrarily falling power (AFP) in alternating current modes. PEO coatings were formed on the samples of wrought aluminum alloys, which are normally used for the manufacturing of the diamond grinding wheels bodies. The influence of PEO factors on Ra roughness index as well as porosity, shape and size of the structural particles of the coatings surface was studied. It was established that PEO increases the reference Ra value by a factor of 2…6, depending upon the electrolyte composition and the processing mode. The "liquid glass" (a technical-grade sodium silicate solution) concentration is the key driver of Ra index, its decrease from 12 g/L to 6 g/L leads to roughness reduction by 25…40 %. An extreme dependence of Ra index on anode current density in GS mode is identified in the electrolytes with the minimal concentration of the alkaline component of KOH solution. It was demonstrated that the morphology research results qualitatively correlate with the microgeometric and functional coating characteristics.

Keywords: Roughness, Porosity, Surface, Morphology, Conglomerates, Electricity Mode, Arbitrarily Falling Power, Galvanostatic Mode, Alkaline-Silicate Electrolyte, Liquid Glass, Outer Layer.

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Forecasting of Overloading Volumes in Transport Systems based on the Fuzzy-Neural Model

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The article deals with the expediency of evolutionary models application for obtaining the forecast carried out with the minimal error. In research the analysis of modern approaches to the creation of qualitative forecasting models of overloading volumes of cargo in ports with the use of modern methods was carried out. The relevance of using of such network as ANFIS for forecasting of future delivery volumes of grain to the port is proved by calculation method. Conclusion about the best forecast by means of the model by ANFIS is executed by on the comparison with the results of an ARX system. Use of the last type gives bigger error than the fuzzy-neural model. In research, the preprocessing of the entering data was carried out. This information is presented in the form as time series, which contain 1095 values. The selection procedure of allowed to adjust basic data in terms of the informative ability of each value in time series. The number of the actual input parameters (nodes) in the model is decreased from 7 to 4 after the results of the selection. At the same time, a forecasting error on a control sample made up 4.99%.

Keywords: Fuzzy-Logic, Neural Network, Volume, Forecasting, Grain, Automobile, Transportation.

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Experimental Vibrating Complex for the Research of Pressing Processes of Powder Materials

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An experimental complex on a high pressure casing was developed for the research of vibrating processes of powder materials pressing. As a high pressure casing hydraulic hoses of high pressure pressed to the elliptic state were used. Hydraulic pump - a pulsator - is the upgraded gear pump in which a quarter of one tooth was cut. The modes of transition of a hydraulic motor through resonance were investigated. It is proposed to use the mode of fluctuation switching from coordinate X to Y and vice versa to create vibrating actuators of periodic action with a large vibration traction effort due to the massive energy storage. The developed experimental complex can be used both for one-sided and for dry isostatic pressing. The complex allows to implement spatial variations of the press-mould. The frequency and oscillation amplitude can be regulated. The frequency can be regulated by changing the turns of the hydromotor, and the amplitude - by changing the pressure values in the system. The method of calculating vibration modules on a high pressure casing is developed.

Keywords: Vibration, High Pressure Casing, Powder Materials, Resonance, Fluctuation, Pressure.

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Determination of Parameters of Cylindrical Grinding with Additional Intermediate Dressing

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The searches of technological solutions of the problem of reducing power consumption by metal-cutting machine tools when grinding were performed. For this purpose, it is proposed to perform grinding with additional intermediate dressings of grinding wheels, which should ensure reducing the intensity of heat generation in the cutting zone. Mathematical formulas of tangential cutting force, an effective power, a quantity of heat, grinding time between additional intermediate dressings and dressing time for conventional and proposed dressing schemes are given. Based on the mathematical formulas a computer software for modeling the thermal regime parameters when grinding by introducing into its structure a module for calculating the parameters of grinding with additional intermediate dressings was updated. Multivariate calculation of the parameters of dressing process according to conventional grinding and grinding with additional intermediate dressings was done. An advisable number of additional intermediate dressings is found, depending on the allowable values of the tangential cutting force, a quantity of heat, and time of grinding between the additional dressings.

Keywords: Energy Consumption, Grinding, Additional Intermediate Dressing, Tangential Cutting Force, Quantity of Heat.

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Simulation Study of Cutting-Induced Residual Stress

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The use of the finite element analysis (FEA) is an effective method for studying the surface layer deformation appeared from inherited residual stresses. This paper is devoted to the analysis of the effect of residual stresses to the service properties of parts and the development of a cutting-induced residual stresses simulation using the DEFORM software. The influence of residual stresses on the operational properties of machined parts is investigated. The fatigue strength of the product, which is provided as the result of forming in the cutting process of the surface layer structure, residual stresses and deformations, is used as a criterion for the decision-making about optimal structure and parameters of the functionally-oriented technological process. The causes of the occurrence of machine-induced residual stresses for different workpiece materials have been analyzed. The simulation model of residual machining-induced stresses is described. The functional dependence of the stress-strain state reflects the interference pattern of the frictional, force loads and the variable process of the deep thermal effects. It is proved, that the compression part of this cycle is determined by external load, and tensile - by residual stresses.

Keywords: Functional-Oriented Technological Process, Fatigue Strength, Residual Stress, Simulation Study, Finite Element Analysis, Deform.

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Preventive Maintenance System in a Company from the Printing Industry

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In the face of increasing demand for cardboard packages, proper organisation of production to facilitate rapid response to changing customer requirements has become of utmost importance. The key issue is to maximise equipment uptime and prevent unexpected breakdowns which may halt the production and cause delivery delays which generate delays further in the supply chain. Proper asset management can be supported through the implementation of the Total Productive Maintenance system. This paper presents an original Total Productive Maintenance system developed for a company operating in the packaging industry. The designed documentation and organisation of information flow among the company units aimed at supporting of the TPM system are presented and analysed. The importance of the human factor for the success of the implementation is highlighted, and certain setbacks which may be experienced during the implementation are listed.

Keywords: Total Productive Maintenance, Preventive Maintenance, Mechanical Engineering.

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ICT Support for Industry 4.0 Innovation Networks: Education & Technology Transfer Issues

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In order to ensure effective participation in the global research and innovation space, the development of scientific digital infrastructure according to priority directions is important. In terms of universities, the development of digital infrastructure is crucial for providing open access to scientific data and knowledge, further commercialization of research, innovation, products and services. Therefore, the purpose of this study is to consider the education & technology transfer issues of ICT support for Industry 4.0 innovation networks. Methodology of study is based on system approach to innovation networks development. The study is based on a broad understanding of technology transfer as an exchange of technology, technology knowledge between individuals, enterprises, universities, research centers, and government structures at all levels. The proposed research idea is also based on the concept of integrated technology and the concept of promising (innovation) needs. It is the definition of innovative needs which is a prerequisite for creating a competitive economy, since they determine the qualitative changes in it. It was shown, that application of Industry 4.0 digital and virtual engineering tools allows conducting the R&D processes in computer-aided design systems, which reflects the quality of innovation product and the product launch timing. From the abovementioned perspective,we give the list of the main technological areas of ICT, which form the basis for the high-tech sectors development within Industry 4.0.

Keywords: Digital Infrastructure, Knowledge Transfer, Information Management, InCoUniv, Technological Dynamics.

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Directed Formation of Quality, as a Way of Improving the Durability of Conjugated Parts of Friction Pairs

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In the article the research of possibilities of directed formation of indicators of quality is given, by selecting technological operations and appointment of corresponding processing regimes. Studied approach directed formation of quality, based on the elements of theories of technological inheritance and interference of quality, which can reduce the role of random factors and their complex combinations in the process of providing regulated quality indicators, which in turn reduces the field of dispersion values performance and improves the quality of processed details. It is noted that for implementation of directed formation it is necessary to determine technological parameters, with the help of changing the values of which, it is possible to control the values of their indicators, which evolve in the process of mechanical processing. This will completely eliminate or reduce the impact of those indicators that worsen the performance properties of parts. It was revealed that the nature of manifestations of technological heredity is influenced by the conditions of implementation and the type of technological operations. It is advisable to apply this approach in the initial machining operations in order to initialize the manifestations of those indicators that improve the performance of the parts in general.

Keywords: Analysis, Manufacturing, Coefficient, Matrix, Model.

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Energy Criterion for Metal Machining Methods

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The optimization criteria of manufacturing processes are reviewed. Actual technical, economic and energy criteria used in mechanical engineering technology are analyzed. New energy criterion “action of technological system” is introduced. The proposed criterion is defined as the work of shaping, done over the certain time interval. Investigated criterion is developed for evaluation and selection of technological processes by energy parameters. Mathematic simulation of external turning has been carried out. Analytic relations between the criterion “action of technological system” and cutting parameters have been determined. It has been theoretically established that cutting speed and line feed have the most influence on the investigated criterion. Experimental research of proposed criterion for rough turning and finish turning of external cylindrical surface has been carried out. Empirical relations between the investigated criterion and cutting parameters are determined based on experimental data. Analysis of experimental data for rough turning and finish turning of external cylindrical surface has been provided. Theoretical and experimental data are compared. According to the results, it was proved that line feed and cutting speed have the most influence on the criterion “action of technological system”.

Keywords: Energy Efficiency, Criterion, Action of Technological System, Line Feed, Cutting Speed, Cutting Depth.

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Part II
Materials Engineering

Functional Properties of PTFE-composites Produced by Mechanical Activation

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The influence of the matrix mechanical activation, fillers of various nature and composition on the structure and functional properties of polytetrafluoroethylene composites is explored. The greatest increase in wear resistance at preservation of high values of physical and mechanical properties of PTFE-composites is observed at the synergetic effect of application of the matrix mechanical activation, fillers, their mixing in two-stage mode and use of a binary filler of various chemical nature. It is revealed that introduction of the binary filler increases wear resistance of the developed composites by (2,6–4,1) times in comparison with two-component composites. The feature of the developed manufacturing technology of PTFE-composites consists in preliminary separate preparation of the matrix and fillers before their mixing by mechanical activation in various modes of the equipment therefore there is an increase in level of their breaking strength by 1,4 times and wear resistances by (3,7–6,0) times in comparison with industrial analogs that increases durability of work of frictional units of the compressor by (1,8–2,3) times.

Keywords: Polytetrafluoroethylene, Filler of the Different Nature, Antifriction Composite, Mechanical Activation, Wear Resistance, Properties, Life Level.

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Physical-Mechanical Properties and Structural-Phase State of Nanostructure Wear-Resistant Coatings Based on Nitrides of Metals W and Cr

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The methods of obtaining wear-resistant coatings on the basis of W and Cr metal nitrides are considered in this work, their advantages and disadvantages are characterized. The modes of condensation of such coatings with different component ratios in a magnetron system with constant magnets are chosen. The study of microstructure and structural-phase composition was carried out. It has been established that the influence of the precipitation temperature (600°C) used in this paper has led to a faster growth of grains in the precipitation of Cr-W-N coatings. From the analysis of the elemental composition of the coatings it is possible to observe a clear correlation between the composition of the target and the composition of the coating. Studies carried out on a scanning electron microscope of composite Cr-W-N coatings showed a nanocrystalline structure with a grain size of 50 nm. The microhardness of the obtained coatings was investigated and the obtained results were analyzed. The microhardness of the nanosized coatings was about 3 GPa to cover Cr39W11N50 and 5 GPa to cover Cr75W1N24.

Keywords: First PVD, Second Composite, Third Microhardness.

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The Effect of the Hardfacing Processes Parameters on the Carbide Volume Fraction

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The paper presents the results of research on the possibility of shaping the hardfacing structure by changing the conditions of the surfacing process. The material used in research was high carbon and chromium a self-shielding cored wire giving the hardness 760÷840 HV (62 ÷ 65 HRC) according to the manufacturer. The obtained hardness of the hardfacing was on the same level or was significant higher. The test results show significant differences in the structure and hardness of the deposits, where differences in the amount of carbide precipitations reach 30%, and differences in hardness reach up to 200 HV. The erosion tests showed that impingement angle 30° gives lower erosion rate than angle 60°. It is possible to shape the structure and properties of hardfacing to a certain extent by selecting the appropriate parameters of the surfacing process. In conditions of this experiment the decisive effects on the properties play the parameters like heat input and heat dissipation.

Keywords: Hardness, Heat Input, Structures, Wear.

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Implementation of Pipe Steel Grade X52M Manufacturing according to API-5L Requirements Applied to Hot Rolling Mills "1700"

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For the first time at rolling mill 1700 facilities, PJSC “Ilyich Iron and Steel Works” of Mariupol, the technology has been developed and the batch of hot-rolled coils (8x1260mm) of steel grade X52M has been produced by the method of thermo-mechanical controlled rolling for further manufacturing of electric-welded pipes in accordance with API-5L. This paper confirms the advantages of the thermo-mechanical rolling method due to special features of the chemical composition and lower strength level during the production in comparison to other rolling methods, and the possibility to apply this method at the equipment that was not designed for manufacturing the products of such strength categories. The positive influence of Nb on microstructure forming and rolling products properties has been confirmed with the thermomechanical rolling method. Additionally, during the production, the controlled air cooling of coils has been applied up to 450 oC after coiling. The developed technology makes it possible to ensure the production of coils which meet the present-day world requirements and meet the demands of domestic and foreign producers of electric-welded pipes.

Keywords: Thermo Mechanical Controlled Rolling, Hot-Rolled Coils, Standard API-5L, Technology.

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A New Technology for Producing the Polystyrene Foam Molds Including Implants at Foundry Industry

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Here the description of the possibility of processing technogenic waste polystyrene in binder materials for foundry is provided. The possibility of dissolving polystyrene foam in acetone. Regardless of the amount of acetone that was analyzed, polystyrene absorbs it in a 1:1 ratio, with the formation of a swollen precipitate. The obtained data of the study "polystyrene - acetone" have been successfully used as the basic elements of technology for cellular polystyrene models with implants. Here the prime factor imposing is the kinetics of polystyrene foam in acetone swelling and the swollen foamy polystyrene precipitate composition. The precipitate can be used as a binder for molding compounds. The kinetics of swelling of polystyrene foam and beaded polystyrene in acetone was studied. The data obtained in the study of the system "polystyrene foam - acetone" was used in the manufacture of polystyrene models with implants. The technology for producing polystyrene foam models with implants includes the need to use a special binder for fixing implanted granules on the surface of implanted granules. The research results allowed to propose a new technology for producing foam polystyrene models with implants without using a special binder.

Keywords: Foam Polystyrene Model, Foundry, New Bonding Materials, Acetone, Binder, Polymer. .

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Prediction of Lankford Coefficients for AA1050 and AA5754 Aluminum Sheets using Uniaxial Tensile Tests and Cup Drawing Experiments

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Rolled sheet metals show different mechanical properties and stretching ability in different directions. Anisotropy of these metals should be defined in order to model the behavior of material in different directions for forming operations. Plastic anisotropy of sheet metals is characterized by Lankford Coefficients (R-values). Uniaxial tensile tests are usually employed to determine Lankford coefficients. However, some metals, like aluminum, have limited elongations under uniaxial tension, and the accuracy of tensile tests may be adversely affected due to low elongation before fracture. Recently, instead of uniaxial tensile tests, cup drawing approach is preferred to determine anisotropic properties of sheet metals with low uniaxial elongations. In this study, uniaxial tensile tests were carried out to obtain Lankford Coefficients of AA1050 and AA5754 aluminum sheets in the rolling direction (RD), diagonal direction (DD) at an angle of 45° to rolling, and perpendicular (transverse) direction (TD) to rolling. Subsequently, cup drawing experiments were conducted to predict Lankford coefficients using an analytical approach based on relevant literature. The results obtained from uniaxial tensile tests were compared with those obtained from cup drawings.

Keywords: Plastic Anisotropy, Plastic Strain Ratio, Tensile Testing, Deep Drawing.

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Simulation of the Influence of High-voltage Pulsed Potential Supplied During the Deposition on the Structure and Properties of the Vacuum-Arc Nitride Coatings

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TiN films have been deposited on stainless steel plates using plasma based the ion implantation & deposition (PBII&D) with a negative pulse voltage from 850 to 2000 V. According to the results of X-ray structural analysis, the formation of titanium nitride with a cubic crystal lattice of the NaCl structural type is seen to occur. Computer simulation allows determining the depth of the layer that is exposed to the radiation, taking into account all the cascade damage. The depth of the layer varies from 3 to 4.4 nm with an increase of negative impulse potential (Uip) from 850 to 2000 V, respectively. A transition of the texture from [111] to [110] is present in TiN coatings with an increase of Uip. In the case of a pulse duration of 10 μs and 16 μs in the entire range of Uip used, the following dependences are observed: with the increasing Uip, the deformation of the crystallite lattice decreases with the axis of the texture [111] and increases with the corresponding deformation in the crystallite with the axis of the texture [110].

Keywords: Computer Simulation, Particle Energy, Structural Engineering, Texture.

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Modeling of Processes for Creation New Porous Permeable Materials with Adjustable Properties

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In this work, forecasting, modeling the patterns of formation of the structure and properties of materials, taking into account the size of the structural elements of the charge, establishing physical connections between the components, structure and properties of the finished product, their operational properties is an actual problem of the material science. Sustained modern trends in industrial development are increasing requirements for the quality of all products types. The practice of calculating new porous materials on fundamental of metal powders shows, that the implementation to the full extent of their strength and exploitation characteristics requires a significant increase in the level of prediction of materials physical and mechanical properties and the development of the new modeling methods, which includes a complex analysis of the materials formation processes. Therefore, the focus is on the model experiments predicting the dependence of the properties of materials on the technological parameters of obtaining products using analytical, numerical and numerical-analytical methods with the help of 3D modeling.

Keywords: Modeling, Structure, Porosity, Packaging, Permeability, Pressure.

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Investigation of Properties of Mg and Al Based Nano Hybrid-metallic Composites Processed through Liquid Processing Technique

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This research paper provides comprehensive and extraordinary efforts to carry out novel mechanical behaviour, corrosion testing and metallurgical characterization of aluminium alloy (Al-6061) and Magnesium alloy (Mg-AZ91D) reinforced nano-hybrid metallic composites processed using the liquid processing stir casting technique. These stir casted hybrid nano-metallic composites were manufactured using nano size reinforcements that are SiC, Graphite and Alumina of a size of ~ 100 nm. The finding of comparative results of casted composites was done by using potentio-dynamic polarization tests in the form of capacitance performance of dielectric properties. The results were reported out and the best results were achieved for aluminium reinforced graphite based composites with better corrosion behaviour performances and high hardness and tensile value of the fabricated composites. The experimental data for Mg- Graphite/ SiC/Al2O3 alloy show good arc-like performance over the frequency range with less impedance. The results also illustrated the good arc-like/weber behaviour over the frequency range examined, and indicate decent corrosion behaviour.

Keywords: Nano-hybrid Metallic Composites, Stir Casting, Aluminium Alloy, Magnesium Alloy, Potentio-Dynamic Polarization Tests, Capacitance Perfomance, Dielectric Properties.

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Application of Microphotogrammetric and Material Science Techniques in the Study of Materials on the Example of Alloy AlZnMgCu

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The dominant trend of our time is the development of nanotechnology research, which is impossible without the usage of scanning electron microscopy in order to obtain qualitative and quantitative characteristics of the studied micro-objects at the micron and submicron levels. When objects have complex organization (microrelief) and its spatial structure is a priori unknown, it is not possible to interpret correctly the spatial organization or configuration based on only visual qualitative research. Therefore, there is no need to develop new methods that would allow three-dimensional reconstruction of micro-objects. The article proposes a method for calculating the fractal dimension of the fracture surface microrelief based on Digital model of relief and solving the problem of the spatial orientation of the investigated plane for the implementation of the correct analysis of the chemical composition of the prototypes using the energy-dispersion method (EDX). It was investigated AlZnMgCu aluminium alloys, which, after preparation, were subject to heat treatment. At the end of the heat treatment, the stretch tests (DIN EN 10002) and shock loads (DIN EN 130148) were followed by further metallographic, microscopic (REM) and energy-dispersive (EDX) investigations. The proposed method and the results of studies confirm the presence of the hardening effect under the used heat treatment conditions.

Keywords: Aluminium Alloy, the Surface, Scrapping, Destruction, Microscopy, Radiography.

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Optimal Parameters of Q&P Heat Treatment for High-Si Steels found by Modeling Based on «Constrained paraequilibrium» Concept

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The article is dedicated to designing the regime of Q&P (Quenching and Partitioning) heat treatment for middle-carbon high-silicon steels 60Si2CrVA and 55Si3Mn2CrVMoNbA in order to improve their mechanical properties. The temperature of suspense of quenching cooling during Q&P treatment was calculated by modeling based on the concept of «Constrained paraequilibrium» proposed by J. Speer. The values of Ms temperature as well as the kinetics of martensitic transformation for both steels were experimentally found to be incorporated into the model. It was derived from the modeling that quenching stage should be finished when reaching the steel temperature within the range of 150…220 oC which guarantees the highest volume fraction of retained austenite in the microstructure (together with tempered martensite). The results of calculations were verified by XRD measurements of retained austenite in Q&P treated specimens being found as 17 vol. % for steel 60Si2CrVA and 28.5 vol. % for steel 55Si3Mn2CrVMoNbA which are lower then predicted values. The probable reasons of this discrepancy are outlined.

Keywords: Q&P, Quenching, Austenite, Martensite, Carbon Partitioning.

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Part III
Mechanical Engineering

Method for Determination of Flow Characteristic in the Gas Turbine System

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The flow coefficient and the hydraulic resistance coefficient are widely used in the simulation of flow in various turbines. Widely used methods for computation of the metering characteristics of the openings designed for gas turbine cooling systems are observed. The methods are based on the use of such notions as discharge coefficient and hydraulic resistance coefficient. The use of the latter is preferable for the design of gas turbine cooling systems, because it correlates the air mass flow rate with the total pressure drop in channels. To use the discharge coefficient for the general cooling system computation algorithm the relation between it and the hydraulic resistance coefficient is established. Proposed method consists in the partition of overall losses of the total pressure in the hole into the elements, in particular inlet pressure losses, outlet pressure losses and friction pressure losses. The air density and the Mach number were defined for each element. It was proposed to take into account the influence the setting angles of openings have on the hydraulic resistance. The method used for computation of the metering characteristics of holes showed a sufficiently good coincidence with experimental data when the pressure ratio values varied in the range of $P_1^*/P_2 = 1$ to 2.5, a relative length of the channel is in the range of $l/d = 6.4$ to 24.3 and setting angles of the opening is 30°, 45°, 90°.

Keywords: Gas Turbine, Cooling System, Flow Characteristic, Hydraulic Resistance Coefficient.

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Cutting Stone Building Materials and Ceramic Tiles with Diamond Disc

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During the repair and restoration of buildings, ceramic tiles and blocks of Al2O3 and ZrO2 are often cut. At present diamond abrasive discs are widely used for these purposes. The cutting process is accompanied by a considerable heat release and heating of the diamond disc. At a temperature of about 600º, the tensile strength of a disc is reduced by a factor of 2 and graphitization of diamond grains occurs. Thus, when cutting stone and building materials with a diamond disc, the disc heating temperature should not exceed 600 °C. In the work, mathematical modeling of the diamond cutting disc heating on a metal base was performed while cutting ceramic materials to determine the time of continuous operation to a critical temperature of 600 ° C. The simulation results obtained showed the dependence of the heating temperature of the disc on the diameter of the latter, the speed of rotation, the minute feed, the grain size and the thickness of the disc. It is shown that by selecting appropriate process characteristics the time of continuous operation can be of the order of 10–12 min without the use of forced cooling.

Keywords: Diamond Cutting Disc, Disc Temperature, Ceramics ZrO_2

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Cavitation in Nozzle: the Effect of Pressure on the Vapor Content

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Two-phase nozzles can work in jet injectors of various applications, including jet heat pumps (steam-water injectors) and thermocompressors. Lack of a reliable description of the mechanism of the evaporating liquid flow limits their use as energy-efficient working bodies. The estimation of effect of the vapor content on the initial pressure and temperature will make it possible to determine the variant of initial parameters, at which the overproduction of the vapor is the greatest. The goal of this work is to investigate the effect of pressure and temperature at the nozzle inlet to outlet vapor content. We use the model of a compressible two-phase medium, the kinetic model of evaporation/condensation. The model also includes the dynamic and mechanical equilibrium of the process. The mathematical model using CFD package of Ansys CFX software considers the dynamic growth of the vapor bubble. The obtained results show the average deviation from the experimental value, particularly 2% for pressure and 10% for speed. Increasing pressure and temperature at the nozzle inlet leads to increasing the vapor mass fraction at the nozzle outlet.

Keywords: Energy Efficiency, Jet Thermal Compressor Module, Liquid-Vapor Ejector, Convergent–Divergent Nozzle, Multiphase Flow, Vapor Nucleation, Phase Change, Concentration of Vapor.

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Control of Operation Modes Efficiency of Complex Technological Facilities based on the Energy Efficiency Monitoring

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The article proposes an approach to the organization of control the operation mode efficiency of the technological facility, which is based on simultaneous control of the power consumption efficiency and technological parameters to identify the causes of inefficient operation. The standards for the controlled parameters have been formed based on the monitoring system data in order to take into consideration the facility operation conditions. The confidence interval to the expected value of the power consumption, which is determined based on the power consumption mathematical model, has been selected as the power consumption standard. The power consumption standard is determined for every day, taking into consideration the actual values of the technological parameters. The proposed control procedure is based on taking into consideration the actual operation modes of the facility, which ensures the correct determination of the control limits and the correct control results, and provides for the possibility of adjusting the standards of the controlled parameters. Joint analysis of control charts allows determining the periods of time when the operation mode of the technological facility was ineffective in terms of power consumption, identifying the reasons that led to it.

Keywords: Energy Efficiency Control, Shewhart Control Charts, Control Limits, Power Consumption Standard, Pumping Stations.

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Performance Comparison of Two Guidance Systems for Agricultural Equipment Navigation

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Cover crops have been gaining popularity in the Northern Great Plains as an effective practice to improve soil health. An accurate guidance system when planting cover crops between rows of standing corn at V6-V8 stage requires precise navigation to avoid damaging standing crop, but field observations showed that the grain cart often trampled over rows of plant. Development of accurate and efficient methods, to find the correct path to guide the farm equipment automatically during these operations is an important need. In this project, the capabilities of Ultrasonic and Tactile navigation sensor (Reichhardt® Electronic Innovation Products) were studied and compared. The objective of this study was to consider the difference between performances of two navigation systems that would guide the grain cart tires to move between rows for different operating conditions, speeds, patterns of rows, and terrain conditions. The comparison tests were conducted with five different fixed speeds, variable speeds, and four different row patterns in laboratory conditions on a purposefully designed test bench. The study results show that both sensors can successfully locate/identify row patterns if they are appropriately adjusted. But the steering system of the test bench has failed to respond with respect to the identified rows by the sensors due to a missing feedback controller. Moreover, appropriate digital filters were designed to remove undesired noises of signals read by the sensors and a fit model was found to compute exact physical location of the system with respect to rows.

Keywords: Auto Steering, Implement Guidance, Inter-Seeding, Kinematics, Path Tracking, Tactile Sensor, Ultrasonic Sensor.

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Influence of Discrete Electromechanical Hardening on the Wear Resistance of Steels

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The new way of discrete electromechanical treatment has been developed. The method of hardening a cylindrical surface is based on the creation of linear hardened zones of increased hardness using a roller tool. Analytical dependences and numeral models have been received for determination of contact descriptions at co-operation of instrument and detail for the electromechanics strengthening. By the method of finite elements the conducted analysis tensely deformed to the state of surface after its treatment by discrete electromechanics treatment with different geometrical layout of the locally fixed areas charts. The model of wear and method of determination of descriptions of wear as a result of experimental tests have been developed for prognostication of wearproofness. For the analysis of influence of the tensely deformed state of discrete surface on wearproofness the experimental tests at the discrete electromechanical strengthening have been conducted. The obtained results indicate that the wear of samples significantly depends on the slip speed. Examined electromechanical treatment samples have a high wear resistance at high slip speeds.

Keywords: Surface of Friction, Strengthening, Wearproofness, Tensely State, Computer Simulation, Laboratoryr Test.

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Parallel Solution of Dynamic Elasticity Problems

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An algorithm for parallel solution of the dynamic problems of the elasticity theory for axisymmetric objects as a three-dimensional problem of the elasticity theory has been proposed. The semidiscrete approximations reduce the problem to the solution of the Cauchy problem for a system of linear differential equations of the second order. The elements of the matrix are determined with the help of the semi-analytical finite element method (FEM) using the Fourier series analytical expansion by trigonometric functions of the angle coordinate and numerical expansion of isoparametric approximations on serendipity quadrilaterals in the meridional section. The Cauchy problem is solved by decomposing the solution into eigenfunctions, which we find using the subspace iterations method. The method has been parallelized with domain decomposition and message passing interface (MPI), and the parallelized method has been scaled to over 20 processors with high parallel performance. The numerical examples have demonstrated the performance of the proposed algorithm. The numerical results indicate that the method is very accurate and its parallelizations are efficient for both types of problems.

Keywords: Axisymmetric Anisotropic Objects, Dynamic Elasticity, Finite Element Method, The Eigenvalue Problem, The Algorithm of Parallelization.

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Wear Resistance of Hardened Nanocrystalline Structures in the Course of Friction of Steel -Grey Cast Iron Pair in Oil-Abrasive Medium

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The results of the research studying the influence of modified hardened surface layer after friction hardening on wear resistance in the course of oil-abrasive wear of steel-grey cast iron friction pairs are presented. Friction hardening is one of the surface hardening methods with the use of highly concentrated energy sources. A nanocrystalline hardened (white) layer is formed in the surface layers after the friction hardening. The thickness and microhardness of the hardened layer depends on carbon content in the steel and its preliminary heat treatment. Thus, thickness of the hardened layer was 120 μm, and microhardness was 5.6 GPa, with the initial structure hardness of 3.2 GPa, in hardened and high-tempered test-pieces of Steel C45 (EN) after the friction hardening. Grain size of the hardened surface layer was equal to 20-40 nm near the treated surface.It is shown that the hardened layer significantly increases performance of the pair "Steel 41Cr4 (EN)-Grey cast iron EN-GJL-200" during sliding friction in oil-abrasive medium. When increasing the unit load area from 2 to 6 MPa, wear rate of the hardened pair decreased by 2.1-3.7 times in comparison with an unhardened pair. Only one component of the friction pair was hardened.

Keywords: Nanocrystalline Layer, Friction Hardening, Wear, Oil-Abrasive Medium.

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Efficiency Analysis of Gas Turbine Plant Cycles with Water Injection by the Aerothermopressor

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Improving the efficiency of gas turbine plants has been solved in two main directions: by intercooling the cyclic air between the stages of compressors; by increasing the amount of working fluid in the cycle with heat recuperation. Technology of cyclic air cooling of gas turbine plants is based on the hypothesis of thermogasdynamic compression and cooling, which consists in increasing the pressure as a result of instantaneous evaporation of the dispersed liquid injected into accelerated superheated steam flow or gas flow. In the paper it has been presented the basic schemes of the aerothermopressor installation along the gas turbine plant path. Seven variants of gas turbine plant cycles are analyzed and scheme-technical solutions are determined by using the aerothermopressor to obtain optimal operating parameters of the gas turbine plant. The efficient increasing of values of gas turbine plant has been determined, in the cycle with intercooling of cyclic air the efficiency is 46.9% and in the cycle with heat recuperation is 55.2%.

Keywords: Thermogasdynamic Compression, Efficiency, Cyclic Air Cooling.

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A Simulation Tool for Kinematics Analysis of a Serial Robot

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Robot programming is a very significant task in the field of robotics. Off-line programming (OLP) is a method performed before robot manipulation. It is the manual editing of the robot code using computer software to simulate the real robotic scenarios. Task sequence planning, short-term production, flexibility during operation and expecting real behaviour of the robots are some of the reasons that make the users prefer OLP. Operations can be visualized in many processes such as welding, cutting, even medical applications. In this study, off-line models are offered including the forward and inverse kinematics of a six Degree-Of-Freedom (DOF) serial robot manipulator (Denso VP-6242G). Robotic Toolbox combined with GUI Development Environment in Matlab® is used for the forward kinematics solution. A Matlab® Simulink model with Simmechanics blocks is used in the inverse kinematic analysis. Visualization is enriched by 3D Solidworks® models of the robot parts. Basic motion examples that can be used in many areas are presented.

Keywords: Off-line programming (OLP), Denso VP-6242G, Forward and Inverse Kinematics, Robotic Toolbox.

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The Imitation Study of Taper Connections Stiffness of Face Milling Cutter Shank Using Machine Spindle in the SolidWorks Simulation Environment

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The article deals with the radial stiffness increase of face milling cutter taper with a shank 7:24 using a machine spindle. The stiffness increase of such connections is possible by means of a face milling cutter shank with two-contact centering faces design. In this case, a smaller centering face is proposed to design hollow with reduced radial stiffness. In the paper, we have carried out the stiffness imitation study and considered a face-milling cutter taper connection stress-strain state with an improved shank under loading with a machine spindle using SolidWorks. To perform simulation modeling, we have used a parametric 3D model of taper connections static behavior in which external and internal tapers dimensions are associated with certain deviation limit through the SolidWorks equation tool. The parameters of the computational process of nonlinear static analysis in the simulation module have been determined. The parametric model boundary and kinematic conditions have been considered. It has been determined that standard simulation tools use for carving force simulation leads to stiffness system artificial increase. Therefore, in the paper, to simulate the impact carving, we propose to use specially created orthotropic material thermosetting forces. The imitation study shows that face milling cutter shank with two centering faces of all deviation limits leads to higher stiffness connection (smaller radial displacements).

Keywords: Hollow taper shank, Radial displacement, Nonlinear Analysis.

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Mathematical Modeling of Operating Process and Technological Features for Designing the Vortex Type Liquid-Vapor Jet Apparatus

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The article discusses the design features of vortex type liquid-vapor jet devices in the form of an oblique cut-off nozzle of the motive flow while entering the vortex chamber. Mathematical modeling allows proving the influence of the oblique cut to a deflection of the flow from the nozzle axis by a certain angle. This model is based on a continuity equation in the modified Baer's form for the adiabatic process of discharge from the expanding nozzle with an oblique cut, as well as on the fundamental laws of thermodynamics for operating process. The proposed mathematical model allows determining the analytical dependence between the deflection angle of the flow from the nozzle axis in an oblique cut for an expanding nozzle and the following geometrical and physical parameters: the oblique angle of a nozzle, the taper angle of a nozzle, the initial pressure in front of the nozzle, the medium pressure at the outlet of the nozzle, the maximum nozzle expansion, and physical properties of the flow. The results of mathematical modeling of the flow deflection in an oblique cut of the expanding nozzle are presented analytically and graphically. Finally, it is proposed the methodology for numerical calculations of geometrical and operating parameters for ensuring the proper operating process, as well as it is described the technological features for designing the vortex type liquid-vapor jet apparatus.

Keywords: motive nozzle, oblique cut, mathematical model, Mach number, adiabatic index, flow deflection angle.

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Dynamic Stress State of Auxetic Foam Medium Under the Action of Impulse Load

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The paper presents studies on the application of the boundary integral equation method for investigation of dynamic stress state of negative Poisson's ratio foam media with tunnel cavity under the action non-stationary loads. In case of the plane problem, the distribution of normalized hoop and radial stresses were obtained for the action of non-stationary impulse load, which was applied to the boundary of cavity cross-sections. For the solution of the non-stationary problem, the Fourier transform for time variable was used. In Cosserat elasticity for the application of the boundary integral equation method the Fourier transform potential representations of displacements and microrotations were written. The fundamental functions of displacements and microrotations for the two-dimensional case of Cosserat continuum were built. For the solving of time-domain problem the system of singular integral equations was written. For numerical calculations the method of mechanical quadrature was applied. Numerical example shows the comparison of dynamic stress distribution in the foam medium with negative and positive Poisson's ratio under the action of impulse load.

Keywords: Negative Poisson's Ratio, Cosserat Elasticity, Time-Domain Problem.

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Improvement the Performance of Liquid Purification by Dynamic Rotary Filters

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Liquids purification from solid mechanical admixtures is a topical problem in many technical applications. Promising way to improve the performance and to reduce the cost of purification is using the dynamic filtration principle on the base of rotating filter element. This principle is known to be successfully utilized in thin membrane filtration applications. Wide use of rotational filtration in liquid systems of vehicles and industrial equipment requires theoretical study for larger rotational and filtration rates as well as consideration of porous baffle with lesser hydraulic resistance.

The numerical approach is elaborated for simulation of liquid phase motion in a rotary filter with a porous filtering cylinder and support framework. The vortical flow motion in the gap is detected to be a factor leading to significant local increase of filtration velocity and even to exclusion the part of filtering surface from operation.

The modeling approach for particle motion study in the stable flow outside of rotating porous cylinder is substantiated. The possibility is demonstrated in deterministic consideration to prevent under definite conditions contact of particles with the filtering surface. It is also shown that maximum influence of centrifugal force on the suspended particle motion can be achieved when particles are an order of magnitude less the boundary layer thickness.

Keywords: Rotating Porous Cylinder, Centrifugal Stability, Suspended Particles.

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Calculation Optimization of Complex Shape Shells by Numerical Method

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The article presents the results of theoretical and experimental studies of complex shape shells performed by the method of curvilinear grids in order to optimize the calculation of strength and stability. It is analyzed the existing numerical methods for calculating shells, such as finite difference method, variational difference method and finite element method. To improve the convergence of finite difference method by reducing error of approximation of hard offset functions the finite element method was used for the first time. Due to this method finite difference approximation was obtained by averaging the tangential strains in a differential interval by using integration of Simpson's formula. This new finite difference scheme was called method of curvilinear grids, the essence of it is thatvector differential relations are firstly replaced by their vector of finite difference analogues, and then the transition to scalar ratios is performed by designing in the local basis. The method of curvilinear grids is applied to calculate a complex shell, formed by a combination of four hypars. The result of calculation is a graph with the dependence of the critical load of the stability loss on the cross-sectional area of the edges. The study of convergence with the obtained results was performed by different methods at different mesh density.

Keywords: Hyperbolic Paraboloid, Shell, Finite-difference Method, Finite Element Method, Stability, Strength.

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Improvement of the Hydraulic Units Design Based on CFD Modeling

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Development of the new hydraulic units for hydraulic drives or improvement of the characteristics of existing aggregates models should be performed on the basis of research results using computer simulation. The possibility of using CFD-module of Flow Simulation for research of hydraulic pressure losses in the design of a hydraulic lock of a working section of a hydraulic distributor by means of computer simulation of hydrodynamic processes of fluid flow under pressure in its 3D-model. A 3D-model of the hydraulic section was developed in Solid Works CAD system. Hydraulic pressure losses during the flow of fluid through a hydraulic lock occur at the output of the injection channel and at the input towards the working channel of the working section of the hydraulic distributor. The loss of pressure is due to the peculiarities of the design of the locking and regulating elements of the hydraulic lock. As a result of computer simulation of hydrodynamic processes of fluid flow under pressure through a hydraulic lock, hydraulic pressure losses are determined. In order to reduce the amount of pressure losses it is proposed to make changes in the design of the hydraulic lock without degrading its performance. The proposed changes in the design of the hydraulic lock have allowed to reduce the amount of hydraulic pressure losses in the working section of the hydraulic distributor, which reduces the overall pressure loss in the hydraulic drive.

Keywords: Hydraulic Drive, Hydrodynamic Process, Computer Simulation.

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Calculation of Hydrostatic Forces of Multi-Gap Seals and Its Dependence on Shaft Displacement

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Using the finite volume method, the problem of a three-dimensional fluid flow through a three-shaft seal of a high pressure centrifugal pump at different values of radial shaft displacements has been solved. Numerical calculations were carried out without taking into account deformation of seals under the influence of uneven pressure distribution. Pressure distributions, leakage values and hydrodynamic radial forces were obtained depending on the magnitude of the eccentricity. As a result of numerical calculations, the dependences of the radial forces on the radial shaft displacement were constructed and the hydrostatic stiffness coefficient was determined. These dependencies were also obtained using analytical equations. The obtained numerical results differ from the theoretical ones less than 5%. It should also be noted that the application of the three-gap seal significantly reduces leakage compared to homogeneous and double-layer seals, as well as increases the radial force stiffness, which in its turn provides a low level of rotor vibration.

Keywords: Radial Force, Multi-gap Seal, Finite Volumes Method.

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The Investigation of Particle Movement on a Helical Surface

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Differential equations of particle movement on the rough surface of the spiral gutter under the effect of the force of its own weight are obtained in the article. Special cases for individual cross-sectional lines (a straight line and a circle) are considered. If the section is an arc of a circle, a spiral gutter is formed. In the particular case when the cross section is a straight line inclined to the axis upwards, then the helical surface is an oblique helicoid. The equations are solved by numerical methods and trajectories of a particle movement along a helical surface are constructed. After the motion stabilizes, the particle has a constant speed and its trajectory is a helical curve. For this particular case, analytical dependencies that allow calculating the speed of a particle and its distance from the axis of the surface were found. The case, when an angle of elevation of the lowest helical curve of the gutter is equal to the angle of friction of the particle on the surface, is also considered. In the case of a spiral gutter, the elevation angle of its lower helical line should be greater than the friction angle in order to avoid congestions during transportation of particles of the technological material.

Keywords: Spiral Gutter, Cross-Sectional Line, Trajectory of the Movement, Differential Equations.

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The Wall Erosion in a Vortex Chamber Supercharger Due to Pumping Abrasive Mediums

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The rapid wall erosion of the settings of pump elements occurs during pumping of two-phase mediums, in the hydraulic and pneumatic transport systems. In these circumstances, it is reasonable to use the jet technology in general and the vortex chamber superchargers in particular. The purpose of the article is to study the wall erosion of the vortex chamber. The mathematical modeling of the flow is carried out by solving the averaged Reynolds equations using a SST turbulence model corrected. Simultaneously with the hydrodynamic calculations the trajectories of abrasive material solid particles were calculated. Finney's model was used to model the wall erosion. It is found that for all values of the flow rates and, accordingly, the concentration of solid particles, a uniform wear of the vortex chamber is observed. To ensure the durability of superchargers it is necessary to increase the thickness of the chamber's walls. In the process of wear, the ratio of diameters of the inflow channels to the diameter of the vortex chamber will increase. It affects the energy characteristics of the supercharger: the efficiency, the amount of medium at the outflow of the device, the vacuum value near the axis. By setting minimum acceptable parameters it is possible to predict the wear of the chamber and calculate the resource of the supercharger without the use of expensive experimental investigations.

Keywords: Power Characteristics, Aerodynamic, Efficiency, Ejector Technology, Two-phase Medium, Vortex Chamber.

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Data Acquisition Procedures for A&DM Systems Dedicated for the Foundry Industry

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The article presents the effects of cooperation with Polish and European foundries regarding the design of procedures useful in acquisition and data mining systems (Acquisition & Data Mining, A&DM). The author's procedures for collecting data from foundry processes, including the topography of data sources, have been presented. These procedures have been associated with the possibilities of extended data analysis, which should be implemented in dedicated A&DM type systems. Specialized systems seem to be the most appropriate tools for rapid analyses of complex production processes (multivariate process). These systems allow to assess the stability of selected process parameters, and subsequently identify the cause and effect relationship related to the quality of castings. The choice of the number and type of parameters that can be associated with anomalies of processes depends on the system user, his knowledge and experience. This paper indicates the importance of dedicated A&DM systems built from scratch, developed in cooperation with a specific foundry.

Keywords: Foundry Database, Data Processing, Multivariate Process, Computer-aided Production, Foundry Processes.

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Choice of Correcting Link for Electrohydraulic Servo Drive of Technological Equipment

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The issue of choosing a correcting link for improving the quality of regulation of electrohydraulic servo drive of technological equipment is considered. The analysis of the methods for correcting the dynamic characteristics of the electrohydraulic servo drives with throttle regulation is performed. For drives built on the basis of standard modules, it is shown the expediency of the serial installation in the circuit of the electrohydraulic amplifier of the correcting link - the real proportional-differentiating controller. The parameters of adjustment of the correcting link are considered to be the time constant and the transfer coefficient of the regulator are considered, as well as the time constant characterizing the inertia of the link. To select the optimal values for the adjustment parameters of the correcting link of the electrohydraulic servo drive of technological equipment, it is recommended to conduct studies in the Simulink environment of the MATLAB application package. Here is provided an example of investigation of the influence of the adjustment parameters of the correcting link on the dynamic characteristics of the electrohydraulic servo drive with throttle regulation. A block diagram for simulation of transient processes in the Simulink environment is presented. The features of the choice of the recommended values of the adjustment parameters of the correcting link of the electrohydraulic servo drives of the technological equipment for the mechanical processing of materials are noted. The transfer function of the electrohydraulic servo drive with the correcting link is obtained.

Keywords: Dynamic Characteristics, Throttle Regulation, Structural Scheme, Transfer Functions, Block Diagram, Transient Process, Adjustment Parameters.

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Simulating the Process of a Bird Striking a Rigid Target

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A model was developed to simulate the process of a bird striking a rigid target. The target is a hinge-supported steel plate and, in the first approximation, it emulates aircraft structural components. The dynamic behavior of the plate is considered within the generalized model to allow for the spatial character of deformation of the structure. The method for solving the equation of plate motion consists in representing the solution as a double trigonometric series. The result is the transformation of the equation of motion to a system of ordinary second-order differential equations integrated by the solution expansion to a Taylor series. The model of a bird's shock action on a plate was developed based on the experimental research. The influence of a plate's angle of impact on the plate strain was studied for a bird-strike case. A comparison of theoretical results with experimental data showed their close fit. The suggested model of the process of a bird striking a plate is used for evaluating the strength of different aircraft components.

Keywords: Shock Interaction, Bird, Strength, Computer Simulation.

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Static and Flow-Rate Characteristics of Centrifugal Pump's Balancing Device with Considering the Random Changes of Its Main Parameters

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Automatic balancing device is one of the basic units of many multi-stage centrifugal pumps. Operating characteristics of such device are determined by cylindrical and face throttles geometrical characteristics which are stochastic by their nature. That is why the deterministic approach can't give valid results. The purpose of this paper is determine the probabilistic the static and flow-rate characteristics of centrifugal pump's automatic balancing device. The random changes of the mean value of the radial cylindrical gap, the face throttle taper, eccentricity and coefficients of losses are taking into account in the presented calculation model. It is shown that the actual value of balancing force and flow-rate in the chamber of the automatic balancing device can be substantially different from the calculation ones. Obtained results allow to estimate the possible values of the flow-rate and axial force in the automatic balancing device due to changes in manufacturing and installation tolerances, as well as to ensure the stable operation of the pump.

Keywords: Cylindrical Throttle and Face Throttle, Flow-rate, Axial Force, Probabilistic Characteristics.

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Improvement of Manufacture Workability for Distribution Systems of Planetary Hydraulic Machines

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The efficiency of the distribution system of a planetary hydraulic motor is provided by the manufacturability of its elements, in particular the distribution windows. To solve the problem of improving manufacture workability for the elements of the distribution system, the shape of the distributor and sleeve valve passages is substantiated. A design model, a mathematical apparatus, and a calculation algorithm were developed. They made it possible to investigate how changes in geometric parameters of a distribution system affect the throughput of a planetary hydraulic motor with passages embodied in the form of a circle. The initial data and initial conditions for the modeling of the distribution system operation with various kinematic diagrams were substantiated. The change in throughput according to kinematic diagrams of the distribution system was investigated. It was established that the increase in the number of working passages of the distributor caused the decrease of the distribution system flow area. The amplitude of the flow area oscillations decreased as well. When discharge passages of the distributor were used as additional working windows, the throughput of the distribution system increased. In that case, the amplitude of the area oscillations was reduced. The critical parameter which determined the operability of the distribution system was the oscillations of the flow area. Therefore, when the distribution systems for hydraulic motors were designed, it was recommended to use additional discharge windows as working passages.

Keywords: Distributor, Sleeve Valve, Distribution Passages, Throughput, Kinematic Diagram, Mathematical Model.

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Signal Processing and Conditioning Tools and Methods for Road Profile Assessment

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This work presents a comparative analysis of a few different methods and tools for road roughness assessment and highlights some practical aspects of using sensors and data acquisition tools including experimental data analyses. In assessment of road profile roughness, geometrical and response type measurement approaches with class 1, 2 and 3 tools (Total Station 06 Leica Geo SystemTM, Laser profilometer by DYNATESTTM, accelerometers of DytranTM, smart phone, GY-61 with in-house designed and developed data acquisition system and analog-to-digital converter with ArduinoTM Uno Board, and Roughometer III from ARRB group Ltd) are employed. Road tests are performed in different vehicle velocities, viz. 20, 30, 40, 50, 60, 70 and 80 km/h. Comparative studies have demonstrated that the RTM approaches with accelerometers are of sufficiently high quality in assessing road profile and evaluating IRI and can be comparable in accuracy with the class 1 geometrical static profilers and class 2 mobile profilometers like laser profiler by DYNATESTTM.

Keywords: Acceleration, Filter, Integration, Response Type Measurement, Road Roughness, IRI.

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Optimization of the Multi-Engine Hydraulic Drives Work for Synchronous Movement of the Working Tools in the Machines

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Based on the analysis of the hydraulic engines synchronization schemes and on the evaluation of impact factors on coordination of the output elements in the engines, this research proposes a mathematic model, which predicts a change of the dynamic features of the hydraulic drive for synchronous movements, the working tools of which include hydraulic cylinders, with two-flow throttle divider. A model is formed on the basis of the force analysis regarding the hydraulic drive elements movement and evaluation of the influence degree on the operating process, particularly, on sizes and nature of the workloads, amount of movements, velocity and acceleration of the output element in the engine. The condition of the absolute synchronization is movements proportionality (linear movements or turning angels) of hydraulic engines by time. The task of synchronization is to provide the acceptable values of the movement inconsistency in two or more working elements. The mathematic model, obtained in the work, enables to carry out theoretical investigations of the dynamic features of the hydraulic drive for synchronous movements, the working elements of which are hydraulic cylinders with two-flow throttle divider. According to the calculation results of the working peculiarities of the system output elements movement, the further tasks on the technological and constructive improvement of the hydraulic engines move synchronization process in the multi-engine hydraulic unit have been set. The carried out studies found the ability to improve the synchronization process of the hydraulic engines in the hydraulic drive thanks to the regulated throttles in the working fluid flow divider.

Keywords: Multi-Engine Hydraulic Drives, Synchronization, Two-Flow Throttle Divider.

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Part IV
Chemical Engineering

Low-Frequency Ultrasound as an Effective Method of Energy Saving During Forming of Reactoplastic Composite Materials

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Various aspects of the application of low-frequency ultrasound with the aim of achieving energy saving in the molding of reactoplastic polymer composite materials are analyzed. The efficiency of ultrasonic technology in the molding of traditional and nanomodified polymers on an epoxy matrix is considered. Features of the origin and development of ultrasonic cavitation in liquid epoxy binders are described. The main parameters of ultrasonic treatment are discussed. The experimental cyclograms of hardening of epoxy binding of "cold" and "hot" curing used in the manufacture of reinforced plastics and obtained without and with ultrasonic treatment are analyzed. The improved designs of the impregnation, dosing and winding units, which are used on the serial impregnating and drying equipment intended for the preparation of prepregs, are considered. An improvement in the structure of cured reinforced composites obtained without and with ultrasonic treatment is established by conducting a comparative analysis of the electron microscopic examination of their microsections and the places of destruction.

Keywords: Polymer, Reactoplastic, Epoxy, Fibrous Filler, Composite, Ultrasonic, Cavitation.

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Numerical Simulation of Aeroelastic Interaction Between Gas-Liquid Flow and Deformable Elements in Modular Separation Devices

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This paper considers modular dynamic separation devices as automatic control systems, which have hydraulic resistance as a regulation object and elastic forces as a control impact. The way for extension of the range of their efficient operation is proposed using vibration-inertia separation process. The related mathematical model of the abovementioned separation process is realized in three stages. This paper deals with numerical simulation of the aeroelastic interaction between gas flow and deformable elements in modular separation devices using the ANSYS Workbench software package. It should be noted that the modules Transient Structural and Fluent are used by system coupling combination. Two-way FSI method is chosen for simulation of aeroelasticity problem. Boundary conditions of symmetry are used for reducing of resource consumption of the problem solution. Methods of the dynamic meshes deforming are considered for additional preventing from negative volumes occurrence, as well as other significant settings for this type of problem are described. The oscillation frequencies of the deformable elements are determined according to the results of a numerical experiment for gas flow inlet velocity in the range from 3 to 6 m/s. The highest oscillation frequency 153 Hz is determined and observed for the inlet flow velocity equal to 4 m/s.

Keywords: Two-way FSI, Dynamic Meshes, Oscillation, System Coupling, Elastic Forces.

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Significance of Swirl Flow Separator Modification in Rainwater Treatment Technology

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The main objective of this paper was to measure the purification efficiency of the liquid stream in modified swirl settler with a baffle inside the tank. It was found that separation efficiency depended on the size of contamination particles and hydraulic load also. It decreased when hydraulic load was increasing and raised magnitude with bigger diameter of solid particles. Analysis of liquid damming brought about measurement of the pressure drop in function of water volumetric flow rate. The resistance coefficient was calculated based on previously conducted research. Theoretical introduction was made about sedimentation phenomenon and interactions between liquid and solid particles brought by gravity force. Based on literature research and manufacturer catalogues, different technical solutions and constructions of purifying devices like sedimentation tanks were presented. Emphasis was given to the swirl settling tanks, since they are one of the newest pretreatment solutions and exhibit high potential for modification, which can results with higher purification efficiency.

Keywords: Swirl Settling Tank, Sedimentation, Flow Motion Resistance, Purification Efficiency, Liquid Damming.

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Development of Technology for Utilization of Sulphate Waste Water of Detergents Production

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The possibility of using sulphate wastewaters containing a surface active agent is investigated, which are the waste of detergents production for regeneration of cation filters. The dependencies are given, allowing calculating the residual content of the surface active agent in the water entering the boilers. It is theoretically calculated and practically confirmed that a small amount of the surface active agent could get into soft water. Over 25 filter cycles were carried out using the regeneration solution prepared from wastewater of the installation producing detergents. The filter cycles have shown that the working capacity is preserved completely and makes up 270-300 g-equiv/m3. The technological scheme is proposed for utilization of suphate wastewater of the installation producing detergents. This scheme allows ensuring stable regeneration of the cation-exchange filters using the sulphate solution.

Keywords: Cation Filter, Regeneration, Sodium Sulphate, Waste.

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Properties of Heat and Mass Transfer Processes in the Tubular Grids with the Heat Exchanger as a Stabilizer

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In article considers hydrodynamic and heat mass transfer performances of simultaneous implementation of the heat mass transfer processes on tubular gratings with the stabilizer and a heat exchanger. The optimal service conditions for the absorber are determined. Analyzing the obtained data, we can conclude that high efficiency of using foam devices with the stabilization of the built-in heat exchangers at the stage of absorption of sulfur trioxide in the sulfuric acid production is shown. Efficient heat dissipation with the help of internal refrigerators provides the de-sired temperature mode of absorption, which allows eliminating all the bulky heat exchange economy in existing systems. The high performance activity of an absorber of the investigated construction is exhibited during the implementation of simultaneous processes. The industrial implementation of the stabilization method of the gas-liquid layer greatly extends the scope of foaming devices and opens up new possibilities for the intensification of the technological processes creating the low-waste technologies in chemical technology and other industries.

Keywords: Hydrodynamics, Heat Exchanger, Mass Transfer, Stabilization, Foam Layer, Tubular Grids, Absorber, Efficiency.

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Production of Pumpkin Pectin Paste

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The expediency of using vegetable-fruit pastes with a high content of pectin for the therapeutic and prophylactic nutrition of people and excretion of radionuclides, heavy metals and toxins is substantiated. The aim of the research is the development of a technology and a small-sized line for the production of concentrated pumpkin pectin pastes with preservation of plant nutrients that have the properties of removing radionuclides, heavy metals and toxins from the human body. Pectin pastes were made from the pumpkin sort Hybrid 75. In the experiments, a method for the preparation of pectin-containing pastes has been realized by hydrolyzing the plant material with the lactic acid and curd whey, which are simultaneously preserving agents.Technological operations for the production of the pectin-containing paste from pumpkin, optimized by the hydromodule of hydrolysis of the raw materials, the temperature, and the length of the process and the method of evaporation of the reaction mass, which provides better extraction of the complex of natural vitamins, tannins and sugars from the raw materials with pectin, more complete preservation of the native properties of the pectin substances, what helps to achieve the high quality of the finished product. The technology and the line for the production of pumpkin pectin pastes and other pectin-containing raw materials have been developed, what provide the preservation in the production of the native plant fruit properties. The developed technological and hardware-technological schemes of the pectin pastes production make it possible to organize their release in places close to the cultivation of raw materials and reduce transportation costs.

Keywords: Vegetable Raw, Vitamins, Process, Hydrolysis, Technology, Radioprotective Properties, Technological Line.

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Calculation of the Residence Time of Dispersed Phase in Sectioned Devices: Theoretical Basics and Software Implementation

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The article deals with a model of calculation the residence time of particles in the granulating and drying devices with vertical sectioning of the working space. The algorithm of calculation the residence time in the granulating and drying devices workspace is described. The model is realized the implemention the author's software product Multistage Fluidizer®. The software product enables to automatize calculation simultaneously by several optimization criteria and to visualize calculation results in the form of 3D images. The perforated shelf constructive parameters impact and fluidized flow during the residence time in the device are fixed. The research proposed the way of defining the particle's residence time in the workspace of the granulating and drying devices in free (without consideration of cooperation with other granules and granulator's elements) and constrained motion regimes. The engineering computation of sectioning devices methodology with fluidized bed of particles is based on the calculation results. The automated calculations results give a base of designing industrial granulating and drying devices.

Keywords: Software, Modeling, Vortex Granulator, Shelf Dryer, Sectioned Device, Hydrodynamics, Optimization.

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Influence of Difference in Density of Solids on Mixing Efficiency in the Designed Static Mixer

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A new design concept of universal set-up for the examination of mixing process of solids using elements of static mixer has been proposed. The designed mixer allows mixing of solids in the measuring range dm ≤ 17 mm. Owing to the complexity of the construction, it is possible to apply many combinations of settings. The study on mixing efficiency for two components differing in density has been performed. The following granular materials of different size of particle were used: polypropylene, quartz sand, silicon carbide and aloxide. It was shown that the increase in the difference between densities of mixed solids causes a deterioration of the final effect of studied process. Selected construction systems were suitable for mixing of granular solids of comparable density. Depending on applied mixing elements and their arrangement, a satisfactory mixing ratio of solids can be achieved. The efficiency of mixing process depends primarily on the construction type of selected mixing element – segment. To ensure a satisfactory mixing efficiency for other systems, it is necessary to apply new constructions of mixing segments.

Keywords: Solid-solid Mixing, Process Efficiency, Equipment Design.

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An Updated Portrait of Numerical Analyses on Spout-Fluidized Bed Incineration Systems

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Biodegradable wastes are becoming a serious problem in terms of health and ecological balance in parallel with the increasing of local and global populations in recent years. These wastes should be disposed in both efficient and eco-friendly ways. Considering biodegradable wastes as an energy source, it is necessary to be sure that those disposal methods should be focused on energy recovery. However, the existing waste disposal methods have not reached technologically targeted lines yet. It is very important that waste-to-energy recovery systems should have high energy conversion efficiency. Nowadays, there are many current studies based on the methods of wastes incineration. One of the most significant among these systems is fluidized or spout-fluidized bed incineration system. Unfortunately, the targeted points of the technological development of these systems in view of efficient energy recovery have not been reached yet. Existing incineration systems and current studies on this issue are generally concentrated on conventional fluidized bed systems. However, there are few studies of new generation spout-fluidized bed incineration systems which increase homogeneity and prevent waste from adhering to inner wall of a combustor. This study is focusedon the conducted numerical studies in this research field. The latest developments and researches on both fluidized and spout-fluidized bed incineration systems will be investigated and discussed. The remarkable results will be pointed out by using the comparison in order to identify the gaps of the scientific literature.

Keywords: Biodegradable Waste, Spouted Bed, Fluidized Bed, Combustion.

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The Process of Environmentally Safe Biochemical Recycling of Phosphogypsum

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This paper focuses on the determining of biochemical treatment feasibility of phosphogypsum with the extraction of useful components, particularly rare earth metals. The possibility of phosphogypsum use as a mineral substrate by various groups of microorganisms in environmental protection technologies allows the application of bioleaching. The results of research show that biochemical leaching is carried out by aerobic bacteria and it arches capable of oxidizing sulfide minerals. The representatives of the genera Acidithiobacillus, Leptospirillum, Sulfobacillus, Sulfolobus, Acidianus, Metallosphaera, Ferroplasma are leading in these processes. Biochemical formalization of the kinetics process and study of the data bank of current developments dealing with using the waste treatment processes have been carried out. The main ecological and biochemical researches, and various mechanisms of microbiological investigation, biochemical modelling have been studied for assessment of biomass productivity of phosphogypsum. Technological scheme of biological leaching of rare-earth metals from PG dumps has been developed. The optimal parameters have been determined under pH = 1.5–2.5 and T = 278–308 K and the efficiency of bioleaching has been estimated.

Keywords: Environmental Protection, Biochemical Process, Phosphogypsum, Rare Earth Elements.

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Semi-Empirical Correlations of Pollution Processes on the Condensation Surfaces of Exhaust Gas Boilers with Water-Fuel Emulsion Combustion

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Experimental research of low-temperature pollution kinetics on exhaust gas boiler condensation surfaces with water-fuel emulsion combustion to obtain approximation equations for prediction of processes development are carried out. Thermotechnical measurements of parameters were carried out by standard methods; a theory of test modeling and planning was used for experiment processing, and statistical analysis - for experimental data treatment. Based on the experimental data the semi-empirical correlation dependences of specific pollution mass from water content of water-fuel emulsion, sulfur content in fuel oil and excess air factor at wall temperatures below the dew point temperature of sulfuric acid vapor have been developed. The regression equation is obtained for determining the specific pollution mass on the low-temperature heating surfaces. The regression equations make it possible to estimate the influence of various factors such as water content of water-fuel emulsion, sulfur content in fuel oil and excess air factor of pollution intensity. The obtained model allows to describe the pollution process adequately and to determine the values of factors where the lowest intensity of pollution is observed. The received correlations and equation for specific pollution mass can be used for determining thermal resistance of pollution layer, which is necessary for designing and operating of the exhaust gas boiler condensation surfaces.

Keywords: Diesel Engine, Low-Temperature Heating Surfaces, Fuel Oil.

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CFD Assessment of Jet Flow Behavior in an Alternative Design of a Spray Dryer Chamber

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Performance of the spray dryer mostly depends on the flow field of a drying air, which is highly influenced by the configuration of the spray dryer chamber. This paper simulates numerically the jet flow behaviour with no swirl entry in an alternative chamber design of a co-current pilot plant spray dryer chamber. In order to explore the hydrodynamics of the air jet flow in the spray dryer, a mathematical model was developed, using a transient three-dimensional Reynolds-average Navier-Stokes equations, closed via the RNG $k-\varepsilon$ turbulence model and solved using Computational Fluid Dynamics (CFD) (ANSYS-Fluent) software. CFD simulation quantitatively captured many features of the jet flow behaviour such as the velocity profile and characteristics of the turbulent jet flow in a specified configuration of the spray dryer chamber of an expansion ratio of 20 and the Reynolds number of 2.07×105. The simulation revealed the jet behaves as a free turbulent jet at these conditions. Results of the simulation give a good prediction in comparison to the experimental data reported in the literature.

Keywords: Hydrodynamics, Drying, CFD model, Simulation.

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Assessment of the Quality of Alternative Fuels for Gasoline Engines

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The use of alternative fuels is a strict requirement of the present day. The threatening ecological situation of the environment, the constant growth of the fleet, the high price of petroleum products and the import dependence of Ukraine in oil fuels does not raise doubts about the need to develop, improve the properties and expand the range of biofuels. One of the possible solutions to these problems is the use of bioethanol, both in pure form and as an additive to gasoline of oil origin. The purpose of this article is to study the effect of ethanol on the performance properties of traditional gasoline, the search for the optimal ratio of alcohol and gasoline for use in internal combustion engines.
Experimental studies have shown that the concentration of ethanol in gasoline 5-7% performance of physical and chemical properties of the fuel does not change at all. If we add 30% ethanol, we have a serious change in the corresponding indicators, and to ensure the physical stability of the fuel, the reduction of its octane number should be sure to use the appropriate additive. Therefore, the use even in high concentrations of alcohol in the production of alternative fuels for gasoline engines is justified.

Keywords: Bioethanol, Gasoline, Operational Properties, Quality, Ecological Purity.

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Kinetics of Sodium Chloride Dissolution in Condensates Containing Ammonia and Ammonium Carbonates

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The kinetics of sodium chloride dissolution under the conditions of gravity deposition in condensates of soda production gas cooling apparatus containing ammonia and ammonium carbonates was studied. The method for calculating the dissolution rate is proposed based on measuring the deposition time of dissolving salt crystals at two points. The method is based on a mathematical model characterizing the change in the particle deposition rate in the dissolution process and taking into account the value of the dissolution rate coefficient. The impact of the temperature and solvent composition, as well as the crystal shape in the solute on the dissolution rate was investigated. It was found out that, with an increase in temperature by 10 °C, the dissolution increases 1.3 times, which indicates that the process is limited by the solute diffusion from the surface of a solid particle into the bulk of the liquid. In addition, it was determined that the dissolution rate coefficient decreases with an increase in the sodium chlorides concentration and the carbonation rate of the solution and increases with increasing ammonia concentration. Testifying the impact of the salt crystal shape on the kinetics of its dissolution showed that it is not crucial within the limits of the experiment accuracy. Using the methodology of experiment planning and regression analysis, an equation was obtained for predicting the dissolution rate of sodium chloride depending on the temperature and composition of the solution.

Keywords: Dissolution, Kinetics, Sodium Chloride, Condensates, Gravity Deposition.

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Patterns of Pollutants Distribution from Vehicles to the Roadside Ecosystems

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This paper focuses on the determination of the motor vehicles pollutants emission and distribution in space and time within roadside ecosystems. The need for improvement of the mathematical model of emission distribution and the spreading of pollutants from highways is related to the non-stationary transport flow. The results of research show the spread of pollutants in the roadside ecosystem is carried out by the transfer of air flows (advective and convective components) and diffusion (fluctuation movements relative to the transfer process). Obtained analytical dependences for the forecast estimations of pollutants concentrations in the air allow to design a spatial concentration field at any atmospheric states and air flow velocity. The adequacy of the developed mathematical model was checked using instrumental methods. As exemplified by sulfur dioxide, it has been determined that its concentration in the air varies exponentially depending on the distance from the road and at a distance of 30 m is reduced three-fold, reaching the level of 0.8 mg/m3. The Ansys 17.0 software visualized the distribution of waste gases from a truck and determined that the bulk of pollutants deposited at a distance of 30 m from the road. The fields of concentration of the respective harmful substances in the roadside zone were obtained and the places of secondary entry of settled harmful impurities from the roadway were determined again in the atmospheric air.

Keywords: Exhaust Emission, Mathematical Modelling, Highway, Air Pollution, Predictive Models.

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Studies on a Simplex Pressure-Swirl Atomizers with a Different Spin Chamber Shape

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Unflagging interest in pressure-swirl atomizers forces continuous development of knowledge about their operation and construction. Although this type of atomizers had been described in a comprehensive way and the number of correlation equations describing atomization process is substantial, some construction features and their influence on the process have not still been described in a satisfactory way. In this study, the influence of modification of pressure-swirl atomizers construction on the values of discharge coefficient and pressure drops was analyzed. A transitory cone in three different variants, cylindrical, conical, profiled, was applied. The construction of the second group of atomizers was enriched with the presence of a blind hole in the swirl chamber. The enrichment of the construction in the form of a blind hole resulted in higher values of discharge coefficient in comparison to atomizers without a blind hole. In the turbulent flow range, the constant value of discharge coefficient, being independent from Reynolds number, was obtained both for atomizers with and without a blind hole. However, these values differed for individual pressure-swirl atomizers. Obtained results can be useful in the analysis and comparison of atomization effects for atomizers of various construction.

Keywords: Pressure-swirl Atomizer, Design of Atomizer, Discharge Coefficient, Pressure Drops.

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Evaluation of Energy and Ecological Indicators of Motor Biofuels

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The purpose of the study is to evaluate energy and environmental indicators of the engine in its work on biofuels and petroleum diesel. Research methods are calculated and experimental. The article deals with the method of evaluation and forecasting of energy and fuel-economic indexes of the engine by using biofuels. The authors indicate the engine power and fuel consumption due to the quantity and heat of combustion for fuel-air mixtures operating on biodiesel, biogas, and diesel oil on the developed method. To determine the heat of combustion of fuel-air mixtures authors used lower heat of fuels combustion. The analysis shows that engine working on petrodiesel has the highest capacity and lowest fuel consumption. On the contrary, the engine working on petrodiesel has some indicators. Emissions of harmful substances of the engine D-243 at various speed and loading modes when working on different fuels were determined with the experimental method. Quantitative values of fuel consumption and emissions of harmful substances were obtained by method of mathematical modeling in the process of moving a technological vehicle for a ride cycle using various types of fuels.

Keywords: Biofuels, Heat of Combustion, Fuel-Air Mixture, Ecological Parameters.

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Regularities of Solid-phase Continuous Vibration Extraction and Prospects for its Industrial Use

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The results of the substantiation and hardware design of continuous vibroextraction for solid-liquid systems with a small difference in the density of phases are presented, which provide the possibility of determining the rational constructive and technological parameters of vibroextractors and modes of their industrial exploitation. Mathematical modeling and methods of experimental evaluation of the mass transfer efficiency are based on the phenomena of non-stationary mass transfer and hydrodynamics. The mechanism of counter-phase separation of phases during the continuous process and features of mass transfer at all scale levels are described. Theoretical substantiation is given to convective mass transfer taking into account the accumulation component of the substance, which, taking into account the mass return in the zone of mixing, is what discloses the content of this component. The realization of the obtained results allowed to develop the engineering calculation method of vibroextraction in the food industry, high-efficiency energy-saving vibroextractors of continuous action and, based on them, apparatus-technological schemes of rational deep processing of plant raw material for a number of industries.

Keywords: Vibroextraction, Mathematical Model, Hydrodynamics, Mass transfer, Diffusion, Pulsating Flow.

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