ACADEMY OF SCIENCES AND ARTS OF THE REPUBLIC OF SRPSKA

ТЕХНИЧЕСКИ УНИВЕРСИТЕТ ГАБРОВО

ALMA MATER EUROPAEA ECM THE UNIVERSITY FOR LEADERSHIP

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XIV МЕЂУНАРОДНИ НАУЧНИ СКУП
САВРЕМЕНИ МАТЕРИЈАЛИ 2021

ПРОГРАМ РАДА И КЊИГА АПСТРАКАТА

XIV INTERNATIONAL SCIENTIFIC CONFERENCE
CONTEMPORARY MATERIALS 2021

PROGRAMME AND THE BOOK OF ABSTRACTS

Бања Лука, 9 – 10. септембар 2021. године
Banja Luka, September 9th to 10th, 2021

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ОРГАНИЗАТОР НАУЧНОГ СКУПА

Академија наука и умјетности Републике Српске

СУОРГАНИЗАТОРИ

Alma Mater Europaea

Технички универзитет Габрово

ПОКРОВИТЕЉ НАУЧНОГ СКУПА

Министарство за научнотехнолошки развој, високо образовање и информационо друштво

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ЧЕТВРТАК, 9. СЕПТЕМБАР 2021. ГОДИНЕ

- Долазак и смјештај пленарних предавача у хотелу „Босна” у Бањој Луци
- Долазак и смјештај учесника научног скупа који живе изван Бање Луке у хотелима по избору

ПЕТАК, 10. СЕПТЕМБАР 2021. ГОДИНЕ

08,30 Регистрација учесника научног скупа (АНУРС)
09,00 Отварање конференције
09,20 Пленарна предавања
13,40 Постер презентације
14,40 Дискусија
Затварање конференције

17,00 ОКРУГЛИ СТО
Промовисање обновљивих извора енергије у циљу одрживог развоја и смањења климатских промјена

УНЕСКО ПАРТИЦИПАЦИЈСКИ ПРОГРАМ 2020/2021

THURSDAY, SEPTEMBER 9, 2017

- Arrival of the plenary speakers and accommodation in the hotel „Bosna" in Banja Luka
- Arrival of the participants and accommodation in the hotels optionally

FRIDAY*, SEPTEMBER 10, 2017*

08,30 Registration of the participants in the ASARS
09,00 Opening of the Conference
09,20 Plenary session
13,40 Poster presentations
14,40 Discussion
Closing ceremony

17,00 ROUND TABLE
Promoting renewable energy sources for sustainable development and climate shange reduction

UNESCO PARTICIPATION PROGRAM 2020/2021

ПЕТАК, 10. СЕПТЕМБАР 2021. ГОДИНЕ

FRIDAY, SEPTEMBER 10, 2021

СВЕЧАНО ОТВАРАЊЕ СКУПА
OPENING CEREMONY
(09,00 – 09,20)

- Скуп ће отворити и учеснике поздравити академик Рајко Кузмановић, предсједник АНУРС-а

  Academician Rajko Kuzmanović, president of ASARS will give an opening speech

- Поздравни говор министра за научнотехнолошки развој, високо образовање и информационо друштво мр Срђана Рајчевића

  Welcome speechs – Minister of Scientific and Technological Development, Higher Education and Information Society, Srđan Rajčević, MA

Поздравно обраћање гостију
Welcome speeches of the guests

РАДНИ ДИО СКУПА
WORKING SESSION
(09.20 – 15.00)

ПЛЕНАРНА ПРЕДАВАЊА
PLENARY SESSION
(09.20 – 13.40)

9.20 – 9.40 Slavko Mentus
The novelties in the development of Na-ion batteries

9.40 – 10.00 Momir Đurović
Energy prospects in Western Balkan region-Montenegro case

10.00 – 10.20 Tomislav Pavlović
Renewable energy and climate change in Serbia and the Republic of Srpska

10.20 – 10.40 Nenad Filipović
SILICOFCM platform: Computer simulation of drug influence on the cardiomyopathy disease

10.40 – 11.00 Plamen Tsankov
Reducing climate change by installing a new photovoltaic power plant in Bulgaria

11.00 - 11.20 Coffee break

11.20 – 11.40 Ljubomir Majdandžić
Using the solar energy in Croatia

11.40 – 12.00 Vojislav V. Mitić
The Brownian motion fractal nature as a joint property in relation to scale sizes within space and submicroelectronics hybrid integrations

12.00 – 12.20 Isak Karabegović
Collaborative robotics – basic technology of fourth industrial revolutions (industry 4.0)

12.20 – 12.40 Duško Dudić
Perspectives of non-chemical batteries today

12.40 – 13.00 Jovan Vojinović
Application of silver preparations in the treatment of dental caries

13.00 – 13.20 Predrag Dašić
Status and analysis of scientific journals in the field of „Materials science" for the period 1981–2020

13.20 – 13.40 Svetlana Stević
Sustainable water management method for predicting the availability of water resources

ПОСТЕР ПРЕЗЕНТАЦИЈЕ
POSTER SESSION

1. Đenđi Vaštag, Suzana Apostolov, Milan Vraneš, Slobodan Gadzurić
   Nicotinamide-based ionic liquid as a potential copper corrosion inhibitor

2. Sergej.V. Kovalevskyy, Olena S. Kovalevska
   Nanoamplitude resonance vibrations of samples in a strong uniform magnetic field

3. Pylyp Hovorov, Anastasiia Kindinova, Irina Ivankova
   Lighting technology to reduce the effects of Covid-19

4. Rebeka Lorber, Miroslav Huskić, Blaž Nardin
   Mechanical recycling of short carbon fibers and grind carbon fibers reinforced PA66

5. Gorana Mrđan, Đenđi Vaštag, Suzana Apostolov, Milena Rašeta, Tatjana Verbić, Olivera Marković, Borko Matijević
   Investigation of physicochemical properties and potential biological activity of 2-pyridine-(thio)carbohydrazone derivatives

6. Rada Petrović, Dragana Gajić, Darko Bodroža, Zora Levi, Darija Kičić
   Kinetic and thermodynamic study of chromium(VI) ions sorption onto white and green tuff

7. Olivera Klisurić, Aleksandar Oklješa
   Structure analysis of newly synthesized steroidal tetrazoles

8. Nina Busarac, Andreja Radovanović, Petar Ljušić, Strahinja Milenković, Nenad Grujović, Fatima Živić
Review of aluminium alloys and quality control standards in the railway industry

9. Milica Balaban, Silvester Bolka, Rebeka Lorber, Miroslav Huskić, Vesna Antić
Low-temperature equilibration reaction and properties of telechelic siloxane oligomers

10. Saša Zeljković, Mladena Malinović, Sunčica Sukur, Dragana Gajić, Gordana Ostojić, Milica Balaban
Mechanochemically induced synthesis of La2O3

11. Branka Kojić Dugić, Pero Dugić, Tatjana Botić, Branko Despotović, Tatjana Mirković, Mirko Petković
Kinetics of base oil oxidation

12. Duška Bjelobrk, Pero Dugić, Tatjana Cvijanović, Tihomir Predić, Tatjana Botić, Aleksandra Borković, Tatjana Docić Kojadinović
Extraction of petroleum hydrocarbons from soil

13. Ivana Radović, Vojislav V. Mitić, Aleksandar Stajčić, Cristina Serpa, Mimica Milošević, Branislav Vlahović
Fiber shape reconstruction with fractal nature analysis

14. Janja Todorović, Mirzeta Saletović, Dijana Mihajlović, Dragana Gajić, Dragana Blagojević, Dijana Jelić
Development of long-lasting antimicrobial and potential hemostatic nanocomposites (pyrophyllite based) with pvp-coated colloidal silver nanoparticles

15. Tamara Tadić, Bojana Marković, Zorica Vuković, Aleksandra Nastasović, Ljiljana Suručić, Zvjezdana Sandić, Antonije Onjia
Optimization of synthesis of nanocomposite with functionalized magnetic nanoparticles

16. Maja Kokunešoski, Zvezdana Baščarević, Svetlana Ilić, Ana Valenta Šobot, Aleksandra Šaponjić
Synthesis and characterisation of SBA-15 with spherical particles

17. Đurica Katnic, Maja Kokunešoski, Aleksandra Šaponjić, Ana Valenta Šobot, Milica Pošarac Marković
Influence of synthesis conditions on adsorption capacity of SBA-15/alginate adsorbent for removal ions of nickel(II) and lead(II) from aqueous solution

18. Dušan Ilić, Jovan Šetrajčić, Stevo Jaćimovski, Siniša Vučenović
Phonon contribution to the heat capacity of ultrathin crystalline film throughout the entire temperature area

19. Stevo Jaćimovski, Siniša Vučenović, Jovan Šetrajčić, Jelena Lamovec, Goran Jovanov
Temperature dependence of thermoelectromotor force in polycrystal graphenes

20. Zoran Rajilić, Dragana Malivuk Gak
Rough prediction of oscillations by computing maximal instability

21. Aleksandar Savić, Saša Papuga, Jelana Račić
Analysis of the influence of potato preparation on hydrolysis process in bioethanol production

22. Saša Papuga, Aleksandar Savić, Maja Stojković, Damir Dubov
Factorial analysis of the influence of enzyme immobilization on starch hydrolysis for Bioethanol production

23. Ana Valenta Šobot, Jelena Filipović Tričković, Aleksandra Šaponjić, Ana Grce, Maja Kokunešoski
Prolonged exposure to mesoporous silica decrease cell viability in vitro

24. Dijana Đurić, Neđo Đurić
The importance of thermal comfort of the urban environment during spatial planning and construction

25. Vojkan Zorić, Jovana Zorić
Forensic analysis of colored materials in the field of high energies

26. Marko Stepanović, Danijela Maksin, Ljiljana Janković Mandić, Tanja Brdarić, Danka Aćimović, Zvjezdana Sandić, Antonije Onjia
Ultra-turrax based dispersive solid phase microextraction for determination of metals In bottled water

27. Danijela Rajić, Srđan Vuković, Svetlana Pelemiš
Determination the range of alpha particles (AM-241) using pixel detectors

28. Nikola Cekić
Use of terracotta material in formation of facade surfaces

29. Nemanja Stojanović, Aleksandra Janićijević, Aco Janićijević
Thermallyguided dehydration of binuclear $[Ni_2(en)_2(H_2O)_6(pyr)]\cdot 4H_2O$ *complex: a further insight*

30. Milica Preradović, Tomislav Pavlović, Dragoljub Mirjanić
Solar radiation atlas for Gradiška and Višegrad (Republic of Srpska)

31. Dušan Ješić, Pavel Kovač, Borislav Savković, Dražen Sarjanović, Dušan Golubović
Determination of warning products in contact of tool steel and iyothermally improved nodular cast

32. Pavel Kovač, Borislav Savković, Lubomir Soos, Marcela Pokusová, Nenad Kulundžić, Dušan Ješić
Modeling of machinability parameters of high alloyed cast iron during surface grindingprocess

33. Pavel Kovač, Dušan Ješić, Dušan Golubović, Nenad Kulundžić
Production requires an appreciation of the physical and chemical characteristics of the material for machining

34. Pavel Kovač, Borislav Savković, Dragan Rodić, Dušan Ješić
Cutting parameters of material identification using the multi-inputs-multi-outputs fuzzy inference system

35. Lubomir Soos, Pavel Kovač, Dušan Ješić, Borislav Savković
Used batteries and accumulators recycling

36. Mihael Bučko, Marija Riđošić, Milorad Tomić
Optimization of electrochemcal deposition of Zn-Mn-Al2O3 composite coatings

37. Danka Aćimović, Branislava Savić, Tanja Brdarić, Dragana Vasić, Marija Ječmenica Dučić, Milica Ćurčić, Danijela Maksin
Investigation of benzophenone-3 electrochemical degradation on titanium electrode

38. Branka Ružičić, Blanka Škipina, Dragana Grujić, Ljiljana Topalić-Trivunović, Ana Velimir, Aleksandar Savić
Influence of Zinc oxide on the electrical conductivity of printed antimicrobial fabrics

39. Duško Kostić, Mitar Perušić, Radislav Filipović, Zoran Obrenović, Dragana Kostić
The influence of additive concentracion on quality of white aluminium trihydrate

40. Sergej V. Kovalevskyy, Olena S. Kovalevska
Features of implementation of artificial intelligence in machine-building production

41. Zoran Ćurguz, Dragoljub Mirjanić, Neđo Đurić, Zora S. Žunić, Zdenka Stojanovska, Predrag Kolarž
Influence of geological parameters on the concentration of indor radon in the city of Trebinje

42. Bojan Pavičar, Goran Kolarević, Sofija Forkapić, Branko Predojević
Measurement of radon levels in air using the passive method based on the electret technique and the active method based on the device RAD7

43. Milan Pantić
Heisenber ferromagnetic bilayer with dipolar interaction

44. Aleksandar Savić, Gordana Broćeta, Marina Aškrabić, Sonja Panić, Ljubomir Vidanović
Effect of mixing approach on the properties of concrete with different aggregate types

45. Milesa Srećković, Aco Janićijević, Milovan Janićijević, Sanja Jevtić, Slađana Pantelić, Zoran Fidanovski
Modeling formalisms and experiment in the approach of laser beam interaction with material and application

46. Dragan Vujadinović, Svetlana Pelemiš, Milan Vukić, Vesna Gojković Cvjetković
Hazard analysis of the direct biopolymers application in food

47. Vesna Gojković Cvjetković, Željka Marjanović Balaban, Dragan Vujadinović, Milan Vukić
The influence of cold atmospheric plasma on gliadins extracted from gluten free flour

48. Milan Vukić, Svetlana Pelemiš, Dragan Vujadinović, Vesna Gojković Cvjetković
Application of a Non-thermal plasma source for flour detoxification

49. Nenad Stojanović, Radoslav Grujić, Ilija Stijepić
ISO standards and achieving the goals of sustainable development

50. Ljiljana Tanasić, Tamara Erceg, Ivan Ristić, Jelena Tanasić
Application of polyurethane systems for controlled release of agrochemicals

51. Nikola Davidović, Slobodan Obradović
Connecting secondary memories in RAID 0 and RAID 1 array

52. Nikola Davidović, Slobodan Obradović, Ilja Stanišević
Influence of su size on RAID 10 performance with 4 SSDS

53. Milutin M. Živković, Milan M. Milosavljević, Predrag V. Dašić
Review of coating processes in order to improve the performance of hydraulic pumps

54. Srđan Vuković, Danijela Rajić, Svetlana Pelemiš
Nanomaterials as drug carriers for cancer therapy

55. Goran Kolarević, Dražan Jaroš, Dejan Ignjatić, Dragoljub Mirjanić
Tissue type determination based on Hounsfield units

56. Klemen Bohinc
Bacterial adhesion on different dental material surfaces

57. Tijana Adamović, Nataša Trtić, Valentina Veselinović, Ognjenka Janković, Mirjana Umićević Davidović, Verica Pavlić
Prevention of oral infections by using gold nanoparticles

58. Jovan Šetrajčić, Siniša Vučenović, Ljubiša Džambas, Igor Šetrajčić, Stevo Jaćimovski, Ana Šetrajčić Tomić, Dušan Ilić
Biomedical nanomaterials as nano-carriers for targeted transport and delivery of drugs

59. Dražan Jaroš, Goran Kolarević, Dragoljub Mirjanić, Milovan Savanović, Nikola Bosnić
Comparison of dose verification using portal dosimetry and arccheck for volumetric modulated arc therapy

60. Adriana Arbutina, Marijana Arapović Savić, Mirjana Umićević Davidović, Vladan Mirjanić, Irena Kuzmanović Radman
Evaluation of enamel surface using EDI and ESRS index after removal of the fixed orthodontic appliance

61. Zorana Stamenković, Nenad Nedeljković, Vladan Mirjanić, Nemanja Marinković, Vanja Stojić, Ivan Arsić
Treatment of skeletal distal bite by twin block appliance – case report

62. Zorana Stamenković, Nenad Nedeljković, Vladan Mirjanić, Nemanja Marinković, Ivan Arsić, Vanja Stojić
Treatment of crowding by fixed multibracket appliance

63. Đorđe Mirjanić, Jovan Vojinović, Vladan Mirjanić, Marija Vuletović
What influences the selection of toothpaste in the youngest population

64. Bojana Marković, Vojislav V. Mitić, Dušan Milošević, Branislav Ranđelović, Ivana Ilić, Maria Čebela, Branislav Vlahović
Molecule as an integrative component of biophysical systems

65. Đorđe Mirjanić, Milesa Srećković, Vladan Mirjanić, Svetlana Pelemiš, Aleksandar Bugarinović, Dragan Družijanić
Selected results and modeling of the application of laser beams in dentistry on bio and prosthetic materials

66. Stojan Srbinoski, Mitar Lutovac
Using the water footprint method in determining the required amounts of water for the population, industry and agriculture

67. Stojan Srbinoski
Application of gis applications in balancing the required quantities of water in the catchment areas and their management for the needs of the water management activities with emphasis on the management of the existing water supply systems

68. Veljko Đukić, Ognjen Đukić
Advantages and disadvantages of wastewater treatment plants in small settlements

69. Marina Karić
Energy efficient materials in order to reduce energy consumption in construction

70. Jelena Lubura, Ivana Dragičević, Predrag Kojić, Jelena Pavličević, Bojana Ikonić, Oskar Bera
Comparison of the carbon black and biochar impact on the power consumption during rubber mixing

71. Marija Marković Blagojević, Mirjana Stevanović, Bratislav Mikarić
Economic aspects of application of contemporary information and communication technologies in business

72. Radmila Lišanin, Čedo Lalović
Possibilities of using biogas for the needs of cogeneration at the landfill "Kulagić ada" in Kraljevo

73. Rade Biočanin, Esad Jakupović, Sonja Ketin, Mubina Čolaković
Genetic engineering in the function of biological war on a global scale and environmental safety measures

A B S T R A C T S

PLENARY PRESENTATIONS

THE NOVELTIES IN THE DEVELOPMENT OF Na-ion BATTERIES

Slavko Mentus

University of Belgrade, Faculty of Physical Chemistry, Belgrade, Serbia,
Serbian Academy of Sciences and Arts, Belgrade, Serbia

Abstract: Today Li-ion batteries dominate as the power sources for portable electronics (mobile phones, lap-top calculators) as well as for electric cars. Main problem of their use is limited sustainability: the raw materials for their production: lithium, cobalt and nickel, are deficient in earths crust. Potential exhaustion of mining resources treats to disable the production of Li-ion batteries in near future. On the other hand, Na-ion batteries, which work on similar principles to Li-ion batteries, present real sustainable alternative. Namely, the abundance of sodium in earths crust is far higher in comparison to lithium, and furthermore, Na-ion batteries may be produced from very abundant metals, excluding cobalt and nickel. Thus, the development of Na-ion batteries is the subject of interest of a broad number of research groups worldwide. Currently, main flaw of Na-ion batteries is lower energy density (~ 50 % that of Li-ion ones), thus the competetiveness on the market is still always relatively low, enabling for first generation of these batteries only complementary use in low-demanding areas, (for example in grid voltage stabilization). However, recently a number of improvement is realized, which promises a rapid increase of competitiveness of Na-ion batteries in all areas of use. In this work the survey was made of the properties of commercial versions of batteries of first generation. Also recent advances in improvements of anode and cathode materials which may lead to a second generation of Na-ion batteries are sumarized.

Key words: Na-ion batteries, cathode materials anode materials, commercial battery versions.

ENERGY PROSPECTS IN WESTERN BALKAN REGION-MONTENEGRO CASE

Momir Đurović

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Abstract: In order to meet new energy demands and climate targets for 2030 year the member states of EU, as well as those of West Balkan, are requested to introduce National energy and climate plans (NECP) for the period from 2021 to 2030 year. That implies to implement clean, affordable and renewable energies such to reach climate neutral economy by 2050 year. This will require to move towards the long term goals set by Power agreements, what means to perform economic transformations such to reach broader sustainable development goals.

To achieve those goals national long term strategies in Western Balkan countries jointly with EU strategies have to cover, at least, the following in coming 30 years: total greenhouse emission reduction, even elimination, to extend feasible socio economic effects of the decarburization measures, to enable links to other national long term objectives, to make progress on a low greenhouse gas emission economy by encouraging use of renewable energy sources such to approachEuropean green plan.

All those measures will lead energy sector in Western Balkan (WB6) to be organizedsuch that it will function with: diversify sources of energy, secure fully functional integrated energy market, free flaw of energy, improved efficiency by reducing needs for energy imports; move to low carbon economy by promoting research and innovations in low carbon and clean energy technologies, what will all lead to extensive implantation of renewable energy sources and control of climate change in the region.

Key words: Energy prospects, Montenegro case, National energy and climate plans.

RENEWABLE ENERGY AND CLIMATE CHANGE IN SERBIA AND THE REPUBLIC OF SRPSKA

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Abstract: The paper focuses on the use of renewable energy sources in Serbia and the Republic of Srpska and their impact on the environment and climate change. Renewable energy sources used in Serbia are hydropower, solar energy, wind energy, biomass, and biogas. Renewable energy sources used in the Republic of Srpska are hydropower, solar energy, biomass, and biogas. When using hydropower, lakes are often formed impacting the microclimate of the environment in which they are located. Photothermal and photovoltaic solar radiation conversion installations are mostly stationary, do not emit harmful substances into the environment, and have no impact on climate change. The use of wind turbines has a certain influence on the flow of ambient air. When using biomass and biogas, combustion gases are released into the atmosphere, which has a certain impact on climate change. The paper concludes that the use of renewable energy sources in Serbia and the Republic of Srpska has a negligible negative impact on the environment and climate change.

Key words: renewable energy, hydropower, solar energy, wind energy, biomass, biogas, climate change.

SILICOFCM PLATFORM: COMPUTER SIMULATION OF DRUG INFLUENCE ON THE CARDIOMYOPATHY DISEASE

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Abstract: Cardiovascular diseases are leading causes of death in the Europe. SILICOFCM is a multi-modular, innovative in silico clinical trials platform for the design and functional optimization of whole heart performance and monitoring effectiveness of pharmacological treatment, with the aim to reduce animal studies and human clinical trials. The SILICOFCM platform is based on the integrated multidisciplinary and multiscale methods for analysis of patient-specific data and development of patient-specific models for monitoring and assessment of patient condition through the course of disease.

In this platform fluid-structure coupling for left ventricle was introduced. A nonlinear material model for heart wall using constitutive curves which include the stress-strain relationship was presented.

Monodomain model of modified FitzHugh-Nagumo model of the cardiac cell was used. Six electrodes are positioned at the chest to model the precordial leads and the results are compared with real clinical measurements. Inverse ECG method was used to optimize potential on the heart. A whole heart electrical activity in the torso embedded environment, with spontaneous initiation of activation in the sinoatrial node, incorporating a specialized conduction system with heterogeneous action potential morphologies throughout the heart was presented. Body surface potential maps in a healthy subject during progression of ventricular activation in nine sequences were used.

The results with parametric and realistic model of left ventricle where PV (pressure/volume) diagrams depend on the change of Ca2+, elasticity of the wall and the inlet and outlet velocity profile have been presented. It directly affects the ejection fraction.

The presented approach with variation of LV geometry and simulations which include influence of different parameters on the PV diagrams are directly interlinked with drug effects on heart function. SILICOFCM platform includes incorporation of different drugs that directly affect the cardiac PV diagrams and ejection fraction (e.g., angiotensin-converting enzyme inhibitors, angiotensin receptor blockers, nitrates, diuretics, calcium channel blockers). Computational platform like SILICOFCM for sure will open a new avenue for in silico clinical trials as well as a new tool for risk prediction of cardiac disease to specific patient using drug therapy.

Key words: In silico modelling, cardiac disease, cardiomyopathy, left ventricle, fluid-structure interaction, drug release, electromechanical coupling.

REDUCING CLIMATE CHANGE BY INSTALLING A NEW PHOTOVOLTAIC POWER PLANT IN BULGARIA

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Abstract: A three new roof-mounted 10 kWp grid-connected photovoltaic (PV) power plants have been constructed in the Technology Park at the Technical University of Gabrovo, Bulgaria, as part of a project “Competence Center – Intelligent Mechatronic, Eco and Energy Saving Systems and Technologies”. Three different types of technology of the PV modules have been used: monocrystalline silicon (mono-Si), cadmium telluride (CdTe) and copper indium gallium selenide (CIGS). With the new three power plants, together with the existing photovoltaic

power plants in TU-Gabrovo with modules of amorphous silicon and poly-crystalline silicon, 5 different photovoltaic materials can be tested simultaneously. A small 500 Wp mono-Si photovoltaic thermal hybrid solar collectors (PVT) PV system is also constructed. The power plants are equipped with a system for monitoring the meteorological and electrical operating parameters, which measures, displays and stores data on solar radiation, temperature, wind speed, currents, voltages, and electrical power of each power plant. The technical characteristics of the components of the PV plants are given in the paper. Schemes with a basic wiring diagram, disposition of the three PV subsystems on the roof of the building at the technology center are presented. Initial comparative data from software for monitoring of meteorological and electrical operating characteristics of the three different types of PV subsystems are shown. Data on the saved CO2 emissions from the avoided production and transmission of electricity according to the specific ecological equivalent of energy resources and energy for the region of Bulgaria, due to the operation of photovoltaic power plants, are presented.

Key words: photovoltaic module, mono-Si, CdTe, CIGS, grid-connected photovoltaic power plant, monitoring system, meteorological and electrical operating characteristics, smart solar logger, carbon emissions, climate change.

USING THE SOLAR ENERGY IN CROATIA

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Abstract: Europeans continue to face extraordinary challenge sand uncertainty in the irdaily lives, all our efforts will remain focused on protecting citizens and overcoming the crisis. The COVID-19 crisis presents Europe with a challenge of historic proportions. At the request of the Heads of State or Government, the Commission presented a very wide-ranging package combining the future Multiannual Financial Framework (MFF) and a specific Recovery effort under Next Generation EU (NGEU).The Next Generation EU (NGEU) fund is a European Union recovery package to support memberstates hit bythe COVID-19 pandemic. Agreed to by the European Council on 21 July 2020, the fund is worth €750 billion. The NGEU fund will operate from 2021–2023, and will be tied to the regular 2021–2027 budget of the EU's (MFF). The comprehensive NGEU and MFF packages are projected to reach €1824.3 billion.For the European Recoveryand Resi-

lience Plan, the European Commission will for the first time take advantage of its excellent credit rating and borrow on international markets by 2058. Croatia will in the framework of this Mechanism will be available a grant in the a mount of EUR 6.3 billion and loans in the approximate amount of EUR 3.6 billion. For the Republic of Croatia, this means reform sand investments related to the green and digital transition, employment, skills development, education, research and innovation, improving the business environment, efficiency of public administration, health system and more.To deliver the European Green Deal, thereis a need to rethink policies for clean energy supply across the economy, industry, production and consumption, large-scale infrastructure, transport, food and agriculture, construction, taxation and social benefits. From all the above, and in order to achieve the European Green Dealandthe Green Transition, one of the important area sin Croatia is the use of solar energy, which will be discussed in more detail in this paper.

Key words: Multiannual Financial Framework (MFF), NextGeneration EU (NGEU), European Recovery and Resilience Plan, grant, green and digital transition, European Green Deal, use of solar energy.

THE BROWNIAN MOTION FRACTAL NATURE AS A JOINT PROPERTY IN RELATION TO SCALE SIZES WITHIN SPACE AND SUBMICROELECTRONICS HYBRID INTEGRATIONS

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Abstract: One of the most important fractals' characteristics is that they are scale-independent which provides the possibility to apply fractal analysis on any scale existing in nature, including space, like macro, micro, or nano. It means that we can apply fractal nature characterization on large or small space bodies, as well as on microelectronic ceramic materials and also on biophysical systems, considering fractal nature as a general phenomenon within the whole Universe, com-

prising alive and nonalive matter.Submicroelectronics hybrid integrations imply the integration of biophysical and condensed matter systems structures, which is possible due to fractal nature self-similarities of Brownian motion, represented by living and nonliving systems particles motion. Electrons and other submicroparticlesBrownian motion is the joint property of biophysical and condensed matter systems because these particles „don't recognize" which system they are a part of, thus their properties and motion are identical in both systems. If we presume the existence of some kind of alien life forms in space, we can consider theliving and nonliving space systems integrationtoo, also in the frame of Brownian motion fractal nature.The goal of our research is to open new frontiers for complex integrations regardless of scale size, from submicroelectronics hybrid systems, up to the space level in the sense of exploring existence of life and intelligence on other space bodies.

Key words: Brownian motion, fractals, space, hybrid integrations.

COLLABORATIVE ROBOTICS - BASIC TECHNOLOGY OF FOURTH INDUSTRIAL REVOLUTIONS (INDUSTRY 4.0)

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Abstract: The name "Industry 4.0" appears in 2011 at the Hanover Fair in Germany, and the changes taking place in the world industrial and digital scene WEF - World Economic Forum (held in 2016 in Davos) gave it the name of the Fourth industrial revolution-Industry 4.0. Industry 4.0 represents a vision of advanced industrial production, which is already partially implemented today by implementing new technologies in the automation of production processes, data exchange and processing. Within the fourth industrial revolution, a new value chain is formed, which primarily relies onthe Cyber-Physical System (CPS), which is also another name for the "Internet of Things", and its service is usually realized in the Cloud (Cloud Coputing). The development and implementation of the fourth industrial revolution "Industry 4.0" is based on the following technologies: cloud computing, robotics, automation, intelligent sensors, 3D-printers and radio frequency identification (RFID), which are the foundations of Industry 4.0. From the listed basic technologies of Industry 4.0 we would single out collaborative robotics as a basic technology, because without its development and implementation there is no implementation of Industry 4.0. Collaborative robotics covers a wide range of

robot models with different characteristics and a common goal: to work together with people and help them in their tasks. Collaborative robots work directly with a human, or can simply be found together in a space where one or more people work, and designed to keep people safe, easy to use and extremely flexible in terms of applicability. In the production processes in the world, the first generation industrial robots are mostly installed, and the paper itself shows the trend of robot implementation in the world. An analysis of the implementation of industrial robots in ten top countries in the world in 2019 was made, as well as the implementation of industrial robots per 10,000 workers in production processes.A projection of the application of collaborative robots in the world until 2025 is given. The trend of application of new generation robots will have a growing character in the future, because the goals of the fourth industrial revolution cannot be achieved without collaborative robots, in other words to reach a "smart production process" or "smart factory".

Key words: collaborative robot, industry 4.0, industrial robot, production process, intelligent automation.

PERSPECTIVES OF NON-CHEMICAL BATTERIES TODAY

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Abstract: Vehicle electrification has posed a new challenge for the scientific community. The success of the vehicle electrification processes depends on the ability of scientists and engineers to develop sufficiently cheap and environmentally friendly batteries. The battery powered vehicles, as hybrid or fully electric, are limited in performance by the price and size of the batteries. The electrochemical batteries are in intensive use to power today's vehicles. Environmental and safety risks associated with this type of battery, their price and an limited lifespan are the reasons why great efforts are being made today in the search for a more suitable type of battery. This presentation provides an insight into the achievements of electricity storage in materials without electrochemical processes. The absence of chemical processes would dramatically extend the life of such batteries compared to the existing batteries on the market, and the choice of materials for their manufacture could be more environmentally friendly. Energy density storage is the biggest problem of non-chemical batteries, but their aforementioned advantages over electrochemical batteries justify the further development of such battery systems.

Key words: Non-chemical batteries, battery powered vehicles, performance, price, size of the batteries, energy storage.

SUSTAINABLE WATER MANAGEMENT METHOD FOR PREDICTING THE AVAILABILITY OF WATER RESOURCES

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Abstract: The subject of this paper is water as one of the most important substances on the globe. The motivation for this research lies in numerous conflicting interests regarding water use, especially highlighted in a deteriorated environment, within deficiency of water, deficiency of data and deficiency of proper methodologies for sustainable solutions. The review of different researches, artificial intelligence application, analysing the various models of water management optimization, in conditions of conflicting interests relating to water use, is done. This research aims to investigate water management methods from the aspect of sustainability under the condition of incomplete and uncertain information. This paper analyses the model for predicting the availability of water resources from the aspect of different impacts.

Key words: water management, sustainability, availability, uncertainty, GIS.

APPLICATION OF SILVER PREPARATIONS IN THE TREATMENT OF DENTAL CARIES

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Abstract: Early childhood caries is currently the biggest public health problem in dentistry, affecting 23,8% children under the age of 36 months and 57,3% aged 3-5 years. In our region, it amounts 12% (Serbia) to 35% (Banja Luka) for the younger, and increase of over 50% in the older ones. An even greater problem is non-treatment of existing lesions, which amounts to over 90%, which is a consequence of the very difficult application of classical therapy methods. In developed countries, the only way of treatment before the third year was until recently via general anesthesia, which is impossible to do in the vulnerable ages, where pathology is the most common. In recent years, the widespread use of silver and fluoride preparations in stopping carious lesions has become increasingly common. Silver has long been known in medicine as an agent with antimicrobial and antirheumatic potentials. In dentistry, silver has been used since the very beginning of the scientific phase, primarily through silver nitrate to stop carious lesions (which was abandoned with the introduction of fluoride) and silver amalgam. In recent years, the idea of combining the effects of fluoride and silver in order to stop progression of carious lesion has been revitalized and widely applied. Today, three systems based on the combination of silver and fluoride are used in treatment of caries: silver diamine fluoride (SDF), silver nitrate, and nanosilver fluoride is still in the experimental phase. Silver ions have bactericidal effect, prevent collagen degradation and close the openings of dentinal tubules, while fluorides in high concentrations help the remineralization of dentin and enamel. The preparations can also be used to detect an active carious lesion (it turns black). The advantages of mass application are: a) it does not require removal of the changed tissue; b) simple and short application c) possibility of simultaneous treatment of large number of teeth in one session; d) possibility of application with other materials; e) economically acceptable; f) the possibility of application in the conditions outside the office. Indications are all types of lesions, especially the filling of caries fissures, ruptured deciduous teeth that cannot be restored without a factory crown, to the initial proximal lesions. It can also be used in adults, especially in gerontostomatology for caries in the neck of a tooth and in people with developmental disabilities. A number of systematic analyzes of numerous studies indicate that the efficiency of silver preparations (primarily SDF) in stopping the progression of carious lesion ranges from 65% - 91%. The best results are achieved on mandibular incisors (91,7%) and the worst on the maxillary molars (54%). No significant negative effects were registered, except for aesthetic ones due to dark staining of treated carious lesion, which nevertheless limits the wider application. There are possibilities of alleviating staining with subsequent restorations with aesthetic materials. Nano silver fluoride preparations do not cause staining.

Key words: Silver diamine fluoride, early childhood caries, non-restorative caries treatment.

STATUS AND ANALYSIS OF SCIENTIFIC JOURNALS IN THE FIELD OF „MATERIALS SCIENCE" FOR THE PERIOD 1981-2020

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Abstract: SCI-E and SSCI are one of the main citation databases (CDB) in the world, namely: SCI-E (Science Citation Index, Expanded) in the field of natural and applied scientific disciplines and SSCI (Social Sciences Citation Index) in the field of social science disciplines. For 2020, 9500 scientific journals were indexed within SCI-E, classified into 178 categories (scientific areas of natural and applied scientific disciplines), and within SSCI, 3510 scientific journals were indexed, classified into 58 categories (scientific areas of social scientific disciplines). Scientific journals in the field of „Materials Science" were classified within SCI-E into 10 (ten) categories, while within SSCI there was no category in this scientific field. The aim of this paper is to present the status and analysis of scientific journals indexed in the SCI-E citation database (CDB) for the 10 listed categories in the field of „Materials Science" for the period 1981-2020. The best ranked category out of the above 10 in the field of „Materials Science" for 2020 was the category „Materials Science, Multidisciplinary" (MSMult) with 333 journals. It was also ranked as the first (top-one) category within SCI-E for 2020. The number of different scientific journals for the category „Materials Science, Multidisciplinary" (MSMult) for the period 1998-2020 increased by 190 journals (from 143 journals in 1998, when the category was created, to 333 journals in 2020), with the annual growth index AGI=6.051% for the period 2019/2020 and the cumulative growth index CGI=232.87% compared to 1998.

Key words: Bibliometric analysis, citation database (CDB), scientific citation index, extended (SCI-E), journal impact factor (JIF), „Materials Science".

POSTER PRESENTATIONS

NICOTINAMIDE-BASED IONIC LIQUID AS A POTENTIAL COPPER CORROSION INHIBITOR

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Abstract: In this paper, the possibility of using newly synthesized ionic liquid based on nicotinamide as a potential inhibitor of copper corrosion in an acidic sulfate medium was investigated. Inhibition efficiency of butyl-nicotinamide, [C4Nic]Br on copper corrosion in acidic (pH=3) 0.1 mol/dm3 sodium sulphate solution was analyzed using potentiostatic polarization measurements and electrochemical impedance spectroscopy (EIS). It was found that the investigated ionic liquid has inhibitory properties of the corrosion of copper in acidic media. The inhibitory effect of the test compound is manifested by rapid and spontaneous adsorption of [C4Nic]Br molecules on the copper surface following the Langmuir's adsorption isotherm. As a result, the cathodic corrosion current decreases as well as the polarization resistance of the system increases in relation to the basic solution. Inhibition efficiency of the investigated compound largely depends on the applied concentration.

Key words: corrosion, copper, inhibitors, ionic liquid.

NANOAMPLITUDE RESONANCE VIBRATIONS OF SAMPLES IN A STRONG UNIFORM MAGNETIC FIELD

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Abstract: The paper presents the results of studies of the effect of nanoamplitude vibrations of steel samples in a constant and uniform strong magnetic field on some of their physical and mechanical characteristics. Various technologi-

cal schemes are considered, in which broadband excitation of samples is applied using piezoelectric exciters that convert an electrical signal of constant amplitude in the range from 20 Hz to 20 kHz in the form of "white noise" into a resonant spectrum of natural mechanical vibrations of the samples. The results of such impacts on samples in laboratory conditions are confirmed by standard tests for the hardness of samples, their chemical composition and metallography. These studies confirmed the possibility of volumetric action on the material of the samples for various variants of technological schemes and made it possible to draw conclusions about the prospects of using nano-amplitude resonance oscillations of the samples in a strong uniform magnetic field of permanent magnets for strengthening the samples. It is shown that for samples of eutectoid steel with a carbon content of 0.8%, magnetic resonance treatment of the samples with an electric signal source with a power of only 3 watts for 50 minutes made it possible to achieve a change in Brinell hardness up to 35%. In this case, the formation of a mesh of a reinforcing nature made of lamellar pearlite in the bulk of the sample material was observed. An increase in the amplitude of oscillations of the piezoelectric resonator and, consequently, of the samples leads to an increase in the hardness of the material and the duration of reaching the steady-state value of its hardness, however, the nature of such changes is extreme. The results obtained allow us to conclude that such processing is promising for increasing the wear resistance of non-regrowed cutting tool plates, for increasing the durability of elements of mechanical parts and structures. Also, it becomes possible to expand the list of technological influences on the working surfaces of machine parts, along with surface plastic deformation and heat treatment.

Key words: volumetric hardening, uniform magnetic field, resonance, vibrations, piezoelectric elements, metallography.

LIGHTING TECHNOLOGY TO REDUCE THE EFFECTS OF COVID-19

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Abstract: Currently, the Covid-19 pandemic has brought to the fore the issues of preventing new contamination of the environment, especially aquatic. Under these conditions, lighting technology and disinfection technologies based on the use of radiation in the ultraviolet range open up wide opportunities. Conducted

at the O.M. Beketov National University of Urban Economy in Kharkiv research made it possible to establish the possibility of using ultraviolet LEDs to treat various environments infected with Covid-19, to develop a methodology and a program for calculating ultraviolet LED installations for disinfecting various environments, in particular water infected with Covid-19, to develop the structure and parameters of a prototype installation, as well as the reliability of the main conclusions.

Key words: water disinfection, ultraviolet radiation, LED light sources, germicidal installation.

MECHANICAL RECYCLING OF SHORT CARBON FIBERS AND GRIND CARBON FIBERS REINFORCED PA66

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Abstract: Fibre-reinforced polymer composites are occupying a fair share of structural and lightweight applications, replacing traditional materials whenever possible. Along with many advantages they offer, such as excellent mechanical properties to weight ratio, low price, fast production, the possibility of tailoring the properties for specific applications, etc., on the other hand, at the end of their lifetime they are usually disposed on landfills. Carbon fibre polymer composites (CFRPs) are relatively expensive materials and should be considered for recycling and reuse. Therefore, the influence of multiple cycles of mechanical recycling through grinding and injection moulding was studied. PA66, PA66 reinforced with CF and ground CF were mechanically recycled five times. Mechanical and thermal properties were determined after the first injection, as well as after the 1st, 3rd and 5th cycles of mechanical recycling. The values of mechanical properties (modulus, strength, ..) generally deteriorate, while the thermal properties remain almost unchanged. Part of the change is due to polymer degradation and part is due to fibre shortening.

Key words: mechanical recycling, carbon fibres, PA66, carbon fibre composites, injection moulding.

INVESTIGATION OF PHYSICOCHEMICAL PROPERTIES AND POTENTIAL BIOLOGICAL ACTIVITY OF 2-PYRIDINE-(THIO)CARBOHYDRAZONE DERIVATIVES

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Abstract: Carbohydrazones and their thio analogs represent compounds obtained by condensation of carbohydrazide and thiocarbohydrazide with carbonyl compounds. Due to their structure, relatively simple synthesis, and high reactivity, mentioned derivatives have a wide range of applications in all fields. In this study, ionization constants of four newly synthesized mono(thio)carbohydrazones were determined by applying the potentiometric method. Also, the influence of specific and nonspecific intermolecular interactions on maxima shifting in UV-Vis absorption spectra was investigated and quantified using the linear solvation energy relationships method and Catalan's model. Finally, by applying the DPPH assay, the antioxidant potential of the newly synthesized compounds was determined, and thiocarbohydrazone derivatives proved to be significantly more active when compared to carbohydrazones.

Key words: biological activity, carbohydrazones, DPPH, ionization contants, LSER, thiocarbohydrazones.

KINETIC AND THERMODYNAMIC STUDY OF CHROMIUM(VI) IONS SORPTION ONTO WHITE AND GREEN TUFF

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Abstract: This paper studies the possibility of chromium(VI) ions removal from aqueous solutions using green and white tuff as adsorbents.

Initially, the influence of various parameters (mass of adsorbent, contact time, pH value of solution, temperature and initial concentration of chromium(VI) ions in the solution) was examined. Optimal experimental conditions found to be: mass of adsorbent m=2 g; contact time t=90 min; pH value pH=2; temperature t=30°C and the highest efficiency of hexavalent chromium removal were at the concentration of 2 mg/L. The point of zero charge of green tuff was determined at different sodium chloride solution concentrations, and results showed that point of zero charge was not affected by the ionic strength of the solution and in all three cases was approximately 7,4.

Equilibrium data were analyzed with three linear adsorption isotherm models: Langmuir, Freundlich and Temkin, and experimental data were the best described by Langmuir model.

The thermodynamic study showed that adsorption process was unspontaneous, since positive value of Gibbs free energy. The negative value of enthalpy indicates an exothermic process and physical adsorption. There is an increase in disorder at solid/liquid boundary, which is indicated by positive value of entropy.

Experimental data showed that adsorption of chromium(VI) ions on both green and white tuff is in better agreement with pseudo second order kinetic model.

Key words: adsorption, chromium(VI) ion, tuff, thermodynamics, kinetics.

STRUCTURE ANALYSIS OF NEWLY SYNTHESIZED STEROIDAL TETRAZOLES

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Abstract: Bearing in mind that androstane derivatives with tethered heterocyclic groups at position C−17 show anticancer activity, the aim of this study was a synthesis of novel steroidal derivatives with a tetrazole ring as a substituent at C−17 position, as well as a detailed investigation of their structures. The crystal structures of the two novel androstane derivatives: 3β-acetoxy-17-(1-methyl-1*H*-tetrazol-5-yl)androsta-5,16-diene (**1**) and 3β-acetoxy-17-(2-methyl-2*H*-tetrazol-5-

yl)androsta-5,16-diene (2) were determined at room temperature. The compound **1** crystallizes in the monoclinic system, space group $P2_1$ with the unit cell parameters, a = 9.7390 (5), b = 7.3412 (3), c = 30.5185 (15) Å, β = 96.970 (5)° and Z = 4. The final R factor is 0.059 for 7761 independent reflections and 547 parameters. The compound 2 crystallizes in the orthorombic system, space group $P2_12_12_1$ with the unit cell parameters, a = 7.3721(2), b = 9.8807(2), c = 30.1493(9) Å and Z = 4. The final R factor is 0.041 for 4186 independent reflections and 267 parameters. Hirshfeld surface analysis of studied compounds was performed in order to identify close intermolecular contacts in crystals.

Key words: crystal structure, Hirshfeld surface analysis, tetrazoles.

REVIEW OF ALUMINIUM ALLOYS AND QUALITY CONTROL STANDARDS IN THE RAILWAY INDUSTRY

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Abstract: In this paper, brief review ofaluminum alloysand their properties is presented. Aluminum alloys are one of the most used materials in railway and many other industries. Aluminum alloys are suitable for production of lightweight and good carrying capacity constructions. These alloys are generally resistant to corrosion which makes them applicable in many environments. Classification of aluminum alloys is presented, with main groups of cast and wrought alloys, whereas aluminium alloys of 5xxx and 6xxx series are the most important for railway industry. Properties of 5xxx and 6xxx aluminium alloys are reviewed, especially focusing on the most commonly used aluminum alloys in railway industry: 5052, 5083, 5754, 6005A, 6061, 6063, 6082, and 6106 alloys. Comparison between their tensile and yield strength is given. Aluminum alloy 6082 is currently considered to be the material of choice for testing in friction stir welding of railway vehicle elements. Possibility of fusion and friction stir welding (FSW) is discussed. Some of the relevant quality control standards are listed.

Key words: aluminum alloys, 5xxx series, 6xxx series, friction stir welding - FSW, quality control standards.

LOW-TEMPERATURE EQUILIBRATION REACTION AND PROPERTIES OF TELECHELIC SILOXANE OLIGOMERS

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Abstract: Siloxane equilibration reaction in the presence of appropriate functional disiloxanes is a common method for synthesis of telechelic siloxane oligomers. Due to high reaction temperature, synthesis of hydoxy-terminated polysiloxane are accompanied by number side reactions. In this paper, the synthesis of hydroxy-terminated siloxane oligomers at relatively low temperatures was optimized. The oligomers of the controlled molecular weight was synthesized in the presence of heterogeneous catalyst and characterized by spectroscopic and thermal methods, as well as thermogravimetric analysis - infrared spectroscopy (TG-FTIR) and dilute solution viscometry.

Key words: hydroxy-terminated PDMS, siloxane equilibration reaction, 1H NMR spectroscopy.

MECHANOCHEMICALLY INDUCED SYNTHESIS OF La_2O_3

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Abstract: Lanthanum(III)-oxide (La_2O_3) powders were synthesized by a mechanochemically induced solvent-deficient method using lanthanum nitrate, and ammonium bicarbonate as precursors. The precursor mixture was calcined for one hour at either 600 or 800 °C. This study included an investigation of the formation reactions, crystal structure, specific surface area, and optical properties of synthesi-

zed La_2O_3. The proposed mechanism indicates a complex synthesis with several reactions, some of which are mechanochemically induced. The size of the La_2O_3 nanocrystalline, as determined by XRD, is 22.15±3.9 nm (by using Williamson-Hall plot it is determined that the strain is 1.4×10^{-3} and crystallite size 30.81 nm) while the specific surface is set to 7.04 m^2g^{-1}. The direct bandgap value obtained from reflectance measurement is determined to be 5.37 eV.

Key words: La_2O_3, solvent deficient synthesis, nanoparticles.

KINETICS OF BASE OIL OXIDATION

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Abstract: In order to extend the life of lubricants and meet the application's performance requirements, more and more hydrocracked base oils and synthetic hydrocarbons are incorporated into the formulated final products. Although these base oil are characterized by good oxidative stability, it is still necessary to incorporate different types of oxidation inhibitors into the final formulation. Molecular oxigen, elevated temperature, catalytic action of metals and often the presence of water are the main causes of irreversible process of degradation of hydrocarbon base oils and loses of basic functional properties of lubricants. At the beginning oxidation goes slow, with different lenghts of the induction period. Then there is an increase in speed, with the accumulation of peroxide, and then again speed decrease, which is often accompained by the separation of insoluble high molecular weight products from solution. The induction period represents one of the most important criteria for evaluation of antioxidant potential and predicting the life of the formulated product. In this paper are presented results of monitoring the oxidation kintetics of hydrocracked base oils and evaluating the efectiveness of typical oxidation inhibitors by the standard method ASTM D 2272

Key words: Lubricants, base oils, oxidative stability, induction period, antioxidants.

EXTRACTION OF PETROLEUM HYDROCARBONS FROM SOIL

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Abstract: During the transport and use of liquid petroleum fuels, many accidents are possible that lead to the spillage of certain amounts of hydrocarbons on the ground.Vapors of spilled volatile petroleum hydrocarbons pollute the air, and heavier volatile components migrate through the soil and pollute it. Also, moving through the land, oil hydrocarbons reach the groundwater and pollute it.

The aim of this paper is to monitor the dynamics of hydrocarbons from the distillation range of diesel fuel (180-365 ° C) through the natural structure of the soil during a certain period of time. Subsequently, soil samples from different depths were subjected to solvent extraction in a Soxhlet apparatus. The research was conducted in real conditions at the selected location, which was assumed not to be previously polluted by hydrocarbons. After extraction of hydrocarbons from samples of contaminated soil, their quantity and structure were determined using gas chromatography with a flame ionization detector (GC-FID).

Key words: petroleum hydrocarbons, soil, groundwater, extraction, gas chromatography.

FIBER SHAPE RECONSTRUCTION WITH FRACTAL NATURE ANALYSIS

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Abstract: Polymer composites represent very useful materials due to a possibility to design various properties with the combinationof ceramic reinforcements in the shape of particles and fibers. Thanks to this, composites are being applied in every industry, from commercial products to high performance materials for aircrafts. Microelectronic devices contain polymers and composites as insulators and adhesives, mostly epoxy-based.In order to improve their mechanical properties, such as modulus of elasticity of impact resistance, and endurance, glass fibers are incorporated as reinforcement. For the design of a composite with desired mechanical properties and long-life, thorough knowledge of microstructural changes and fiber-matrix interface is required. Microstructural analysis can also provide insight in reinforcement shape that can enable connection with the physical properties. Fractal nature analysis represents mathematical tool that can be used for the shape and size reconstruction, ensuring prediction of different properties, which is valuable for the future materials processing. In this paper, field emission scanning electron microscopy (FESEM) images were used for fibers microstructure fractal analysis. Reconstruction of fiber shape was obtained successfully, opening the door for the application of fractal analysis shape reconstruction application on other materials, with the future focus on nanomaterials used in microelectronic devices
Key words: Fibers, comoposites, fractal analysis, reconstruction.

DEVELOPMENT OF LONG-LASTING ANTIMICROBIAL AND POTENTIAL HEMOSTATIC NANOCOMPOSITES (PYROPHYLLITE BASED) WITH PVP-COATED COLLOIDAL SILVER NANOPARTICLES

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Abstract: Pyrophyllite clay, modified with PVP coated silver nanoparticles (PYRO-PVP/AgNPs), with recently proved antibacterial activity was prepared. Silver nanoparticles were synthesized by the chemical reduction method of AgNO3 using NaBH4 and poly(vinyl pyrollidone) (PVP) as a stabilizer and excellent dispersant. This research aimed to elucidate the mechanisms and kinetics of AgNPs, along with PVP protective mechanism that are responsible for antibacterial activity towards the microorganisms. Pioneering steps were made toward coagulation studies due to potential of aluminosilicate layered clays to serve as an alternatives to hemostatic agents currently in use. Isoelectric point of pyrophyllite samples with 5, 20, 45 μm diameter particles and PYRO-PVP/AgNPs sample (Ag25mg/L) was evaluated to understand how the anticoagulant or procoagulant properties of the pyrophyllite varied according to the pH of the isoelectric point. Characterization of the PYRO-PVP/AgNPs samples was performed using FTIR spectroscopy, UV/VIS spectroscopy and optical microscope. Release mechanism and kinetics of silver ions were monitored by atomic absorption spectroscopy (AAS). Additionaly, AAS was used for evaluation of heavy metals content in pyrophyllite clay and a simple and cost-effective procedure was proposed for the purification of pyrophyllite. Authors are thankful to the Ministry for Scientific and Technological Development, Higher Education and Information Society of Republic of Srpska for supporting the study through the project No. 19.032/961-78/19.

Key words: pyrophyllite, nanocomposite, colloidal silver, mechanism of release, kinetics.

OPTIMIZATION OF SYNTHESIS OF NANOCOMPOSITE WITH FUNCTIONALIZED MAGNETIC NANOPARTICLES

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Abstract: This study is focused on the optimization of the synthesis of nanocomposite by suspension copolymerization in the presence of functionalized magnetic nanoparticles. The effect of parameters such as type and amount of stabilizing agent as well as the stirring rate of the reaction mixture on the shape and particle size obtained nanocomposite are studied. The magnetic nanocomposite with the best morphology properties was characterized using optical microscopy, FTIR, and mercury porosimetry.

Key words: magnetic nanocomposite, optimization, morphology properties.

SYNTHESIS AND CHARACTERISATION OF SBA-15 WITH SPHERICAL PARTICLES

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Abstract: The template method's synthesis of SBA-15 material with spherical particles is performed using a surfactant Pluronic P123 (non-ionic triblock copolymer, EO20PO70O20 under acidic conditions. Instead of a commercial cosurfactant, a spent HCl solution obtained after chemical treatment of clay purification was provided with synthesis conditions to form spherical SBA-15. Obtained spherical particles have had diameters ranging up to 2 μm. The spherical shape of the particles and their silicate origin was confirmed by SEM and EDS methods, respectively. In addition to the methods mentioned above, XRD, FTIR and the particle size distributed method was also used to characterize the surface characteristic of spherical SBA-15.

Key words: spherical SBA-15, surfactant Pluronic P123, SEM, EDS.

INFLUENCE OF SYNTHESIS CONDITIONS ON ADSORPTION CAPACITY OF SBA-15/ALGINATE ADSORBENT FOR REMOVAL IONS OF NICKEL(II) AND LEAD(II) FROM AQUEOUS SOLUTION

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Abstract: Abstract: Among different ordered mesoporous silicas, SBA-type silicas are the most frequently studied. SBA-15 is an interesting mesoporous silica material having highly ordered nanosize pores and a large surface area so is widely used as absorbents, catalyst supports and drug delivery materials. Alginate as suitable biopolymer supporters improves the inappropriate physical form of mesoporous SBA-15 for practical purposes. Immobilization in polymeric matrix increases the chemical and mechanical stability of mesoporous SBA-15. Influence of synthesis conditions on adsorption capacity of SBA-15/alginate adsorbent for removal ions of nickel (II) and lead (II) from aqueous solution was investigated. Two forms of SBA-15/alginate adsorbent were prepared. Alginate gel was prepared using calcium chloride solution. Adsorption capacity behavior ions of nickel (II) and lead (II) on the two types of SBA-15/alginate adsorbent was carried out using inductively coupled plasma optical emission spectrometry (ICP-OES). Obtained results were compared with results for similar SBA-15/alginate adsorbents.

Key words: Mesoporous SBA-15, Alginate, Biopolymer, Adsorption, Nickel (II), Lead (II).

PHONON CONTRIBUTION TO THE HEAT CAPACITY OF ULTRATHIN CRYSTALLINE FILM THROUGHOUT THE ENTIRE TEMPERATURE AREA

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Abstract: A fundamental theoretical approach to the study of the phonon subsystem influence on the thermal capacitance of an ultrathin crystalline film is presented in this paper. Phonon spectra and possible phonon states are determined by the method of Green's functions, and the result of the analysis of thermodynamic properties of ultrathin films is the derivation of the exact formula for the thermal capacitance of an ideal ultrathin film, which is valid in the entire temperature range. The behaviour of the thermal capacitance of the film is presented graphically and compared with the behaviour of the corresponding bulk structure, in the low-temperature, as well as in the high-temperature areas.

Key words: phonon subsystem, thermal capacitance, ultrathin film, Green's functions.

TEMPERATURE DEPENDENCE OF THERMOELECTROMOTOR FORCE IN POLYCRYSTAL GRAPHENES

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Abstract: Polycrystalline graphene is a structure that occurs more frequently than monocrystalline graphene. The transport characteristics of these 2D structures are important due to their values which are significantly different from their values in beam structures. The paper analyzes the temperature dependence of one of the transport coefficients (thermoelectromotive force) because this dependence can be easily measured experimentally. The temperature dependence of the thermoelectromotive force in polycrystalline graphene is determined numerically in the temperature range of 0.1 – 400 K. The expression for the thermoelectromotive force is found from the Boltzmann transport equation in the relaxation time approximation. Relaxation times and their temperature dependence are adopted from

available literary sources. The results of the temperature dependence of the thermoelectromotive force coefficient obtained theoretically from this analysis are compared with experimentally determined values.

Key words: Boltzmann transport equation, polycrystalline graphene, relaxation time approximation, thermoelectromotive force.

ROUGH PREDICTION OF OSCILLATIONS BY COMPUTING MAXIMAL INSTABILITY

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Abstract: We use Newton's second law of motion assuming a combination chaos with stochasticity. For a measured time series one can compute appropriate force and then better understand and roughly predict behavior of the observed complex system. The force parameter describing instability is of the highest importance. We consider some mechanical experiments and average global temperature.

Key words: chaos, stochasticity, instability, earthquake, global temperature.

ANALYSIS OF THE INFLUENCE OF POTATO PREPARATION ON HYDROLYSIS PROCESS IN BIOETHANOL PRODUCTION

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Abstract: In this paper, the influence of potato peeling on the efficiency of substrate hydrolysis, which was previously treated using ultrasound, was investigated. Pre-sonication lasted 5 minutes at 60 °C. The process of peeling potatoes was observed as a categorical impact with two levels of impact (unpeeled and peeled potatoes), in the applied methodology of factorial experiments. The efficiency of hydrolysis was monitored as the amount of sugar obtained in the hydrolyzate.

Hydrolysis efficacy is tracked as the amount of sugar obtained in hydrolysis. The obtained results were evaluated by analysis of variance and diagnostic statistical tools. It was found that the peeling of potatoes does not significantly affect the overall hydrolysis efficiency of the substrate, which was previously sonicated for 5 minutes at a temperature of 60 °C.

Key words: hydrolysis efficiency, factorial analysis, potatoes, bioethanol.

FACTORIAL ANALYSIS OF THE INFLUENCE OF ENZYME IMMOBILIZATION ON STARCH HYDROLYSIS FOR BIOETHANOL PRODUCTION

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Abstract: In this paper, the influence of enzyme immobilization on the hydrolysis of starch as a starting substrate for bioethanol production was investigated. The study was conducted using factorial experiments for categorical influence on multiple levels, and within the methodology of experiment design (*DOE – Design of Experiments*). The method of preparation of enzymes, alpha amylase and glucoamylase, for the process of hydrolysis of potato starch was observed as a categorical influence, where four procedures were examined. The investigated methods of enzyme preparation were: the use of free enzymes, immobilized enzymes, combination of immobilized alpha amylase and free glucoamylase, and the use of a combination of free amylase and immobilized glucoamylase. As a response to the use of categorical influence, the contents of starch in hydrolysis were observed as the first dependent variable and the total time (speed) of hydrolysis, as the second dependent variable. Most of the examined enzyme preparation procedures were found to significantly affect the dependent variables. Only in the case of the use of a combination of immobilized alpha amylase and free glucoamylase, it was found that there is no significant difference in the starch content in the hydrolyzate compared to the use of free enzymes.

Key words: hydrolysis, enzyme immobilization, factorial analysis, bioethanol.

PROLONGED EXPOSURE TO MESOPOROUS SILICA DECREASE CELL VIABILITY *IN VITRO*

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Abstract: Ordered mesoporous silica SBA-15 structure with high specific surface area enables large pharmaceutical adsorption capacities and promotes its application as a carrier in drug formulations of prolonged-release. The aim of the study was to estimate SBA-15 time and concentration impact on human peripheral blood mononuclear cells viability, as well as cellular morphology and DNA fragmentation in vitro. SBA-15 mesoporous silica treatment impact on cell viability was monitored at 24, 48 and 72 h time points by TB assay, while at the end of the treatment DNA fragmentation was assessed by colorimetric assay and cellular morphology by dual TMRE/DAPI fluorescent staining. SBA-15 cytotoxic potential rises dependently on time and concentration exposure. After 72 h, all tested concentrations were cytotoxic and displayed elevated DNA fragmentation corresponding to a high level of apoptotic and necrotic cells, as shown by dual fluorescent staining. Short term exposure to SBA-15 material or chemical modification that could influence its physicochemical properties could be a way to lower its toxicity.

Key words: SBA-15, cytotoxicity, DNA fragmentation, TMRE staining.

THE IMPORTANCE OF THERMAL COMFORT OF THE URBAN ENVIRONMENT DURING SPATIAL PLANNING AND CONSTRUCTION

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Abstract: Urban areas in Bosnia and Herzegovina have been recording population growth. The city of Bijeljina has undergone major transformations in the appearance and purpose of the area due to the intensive construction process that is necessary to meet the needs of the increased population. The lack of greenery and the increased number of objects on a small area, as well as the intensified traffic lead to discomfort among the population, which is manifested by a number of diseases related to thermal stress. There are many bioclimatic indices used to define the thermal comfort of an area. This paper will present the physiological subjective temperature (PST), which was analyzed for a period of 14 years (2005 - 2018) in the city of Bijeljina. Knowing of the thermal comfort of an area before construction and before creating of a spatial plan is important for reducing of the number of people affected with heat stress and for providing guidelines for planning of a more pleasant environment.
Key words: urban environment, thermal comfort, PST, heat islands.

FORENSIC ANALYSIS OF COLORED MATERIALS IN THE FIELD OF HIGH ENERGIES

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Abstract: Experimental analysis of the obtained samples was performed by scanning electron microscopy with energy dispersive spectrometer (SEM / EDS), on a laboratory instrument brand "JEOL - Tokyo" model "JSM 6460 LV". In order to ensure better electrical conductivity of samples of colored materials, the samples were prepared with an ultrathin layer of gold by a nanotechnological process in a vacuum chamber (which is an integral part of a scanning microscope), and only then recorded and analyzed under different magnifications. Electron microscopy uses beams of very high energy electrons that cause changes in the nuclei of atoms that make up color molecules. The results of the intensity measurement "fell" in the area of wave vectors between (10-7-10-9) cm-1, which corresponds to energies of (2 - 6.5) 10-16 J, and means that the measurement results are the result of characteristic X-rays radiations. Here, the functions Cn (k) are found for all rainbow colors and their maximum abscissas are determined, which are marked with λm. In this case of color analysis at high energies, it was found that there is a law of magnitude λm of the type of paint. Legality can be formulated with the following state-

ment: the largest abscissa of the maximum has a red color and it decreases towards purple, where its value is the smallest.

Key words: Forensic analysis of colors, scanning electron microscopy, distribution superposition.

ULTRA-TURRAX BASED DISPERSIVE SOLID PHASE MICROEXTRACTION FOR DETERMINATION OF METALS IN BOTTLED WATER

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Abstract: The aim of this study was to determine the content of selected heavy metals in bottled natural mineral water, assessing a variation of dispersive solid phase microextraction (DSPME) as the method of preconcentration of the desired chemical species, necessary for measurement of metal concentration on the Inductively coupled plasma emission spectrometer (ICP-OES). Dispersion of Amberlite XAD-7 sorbent particles was promoted by employment of ultra-turrax, which can attain high stirring speeds. The chosen complexing agent was ammonium pyrrolidinedithiocarbamate (APDC). A Plackett–Burman two-level experimental design was selected to screen a large number of experimental factors and to establish their influence on metal recovery.

Key words: Ultra-turrax, DSPME, Design of experiment, copper, nickel.

DETERMINATION THE RANGE OF ALPHA PARTICLES (AM-241) USING PIXEL DETECTORS

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Abstract: Radiation has a great impact on human life and health, so much attention is paid to new types of detectors. The latest type of pixel detectors work like digital cameras. Due to their high resolution, they are used to detect different types of radiation (X-rays, gamma radiation, neutron radiation, alpha radiation). Radiography and computed tomography (CT) use X-ray photons to study the human body and changes in it. Pixel detector technology has been applied in X-ray CT, in prototype systems for digital mammography, in CT images for mammography and for beta and gamma-ray radiography of biological samples. These instruments are also used for purposes such as the characterization of pharmaceutical products, the evaluation and synthesis of new materials, and the detection of counterfeit drugs. This paper provides an overview of the use of pixel detectors and the estimation of alpha particle range using Monte Carlo SRIM simulation software.
Key words: radiation, pixel detectors, alfa particle, dosimetry.

USE OF TERRACOTTA MATERIAL IN FORMATION OF FACADE SURFACES

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Abstract: The attention of the author in this paper is focused on the innovative joining of environmental, natural terracotta material and the artifact one. The design solutions for terracotta facades from all over the world of ecourbarchitecture confirm outstanding scientific and technical and technological achievements, especially those which bring about new esthetic-artistic and material-inspirational image of buildings in the public space through the designing of facade planes of artifact physical structures – buildings. In addition, they bring about the new contemporary spirit of engineering creations and diversified significance in experiencing of ecourbarchitectonic space. The terracotta material in various forms and formats, textures and colors is a magical long-term means for transcription of forms in the artificial universe of urban agglomerations. Through several examples of facades realized in terracotta material, the paper presents exceptional potential for changes of culturological-citybuilding remodeling of micro-ambient entities, be them the already existing or newly designed structures, in order to emphasize the conceptual, environmental and organic rapprochement with natural structures in the environment. The paper accentuates the necessary good understanding of the structure and physical-mechanical properties of the terracotta material, size of the pieces and methods of mechanical fitting for appropriate use. In general, the focus

is on a different strategy and synthetic understanding of contemporary material formation of the living environment with naturalistic appearance. Key words: terracotta material, ecourbarchitectonic structures, contemporay formation, variety of facads, technical and technolgical achievements

Key words: terracotta material, ecourbarchitectonic structures, contemporay formation, variety of facads, technical and technolgical achievements.

THERMALLYGUIDED DEHYDRATION OF BINUCLEAR $[Ni_2(en)_2(H_2O)_6(pyr)]\cdot 4H_2O$ COMPLEX: A FURTHER INSIGHT

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Abstract: Thermally prompted dehydration of binuclear $[Ni_2(en)_2(H_2O)_6(pyr)]\cdot 4H_2O$ complexoccurs within a 326 K to 410 K temperatureregion, presenting an asymmetrical DSC peak. The process is endothermal and results in loss of10 molecules of water accounting for 26.8% of a total mass of the sample. Values of the apparentactivation energy of 71 kJ/mol and 93 kJ/mol were determined by using Kissinger's and theisoconversional KAS approach, respectively. Probable reaction mechanism was determined byDollimore's analysis. Deconvolution of the experimental DSC peak on different heatingrates shows that the mechanism of dehydration changes with the change of theheating regime.Using the linear compensation effect, values of invariant activation energy of 61 kJ/mol as well as of Arrhenius pre-exponential factor of $6\cdot 10^7$ min^{-1} were determined.

Key words: coordination polymer, Ni(II) complex, dehydration, thermal analysis, compensation effect, kinetic parameterization.

SOLAR RADIATION ATLAS FOR GRADIŠKA AND VIŠEGRAD (REPUBLIC OF SRPSKA)

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Abstract: This paper presents an atlas of solar radiation for two locations in Republic of Srpska, Gradiška and Višegrad. Data obtained in this work are from Photovoltaic Geographical Information System (PVGIS) database. This paper summaries calculations of global and direct solar radiation falling on the horizontal surface and global solar radiation falling on the optimally placed surface at two named locations; calculated are also global, direct and diffuse irradiances on fixed and dual-axis tracking solar power plants in Gradiška and Višegrad. At the end, calculated are the amounts of produced electricity from PV solar power plants (1 MWp) at both locations and solar power systems are compared with each other and between the two locations. Although there are differences in the calculated values for global and direct solar radiation falling on the horizontal surface and global solar radiation falling on the optimally placed surface and differences in amount of produced electricity by fixed, one-axis and dual-axis tracking PV solar power plants between Gradiška and Višegrad, they are not found statistically significant by application of Mann-Whitney Test.

Key words: solar radiation, solar energy, solar power plants, PVGIS system, PV.

DETERMINATION OF WARNING PRODUCTS IN CONTACT OF TOOL STEEL AND IYOTHERMALLY IMPROVED NODULAR CAST

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Abstract: During the realization of contact, changes appear on the contact surfaces of the elements of tribomechanical systems, which refer both to the change of roughness and to the changes of their shape or dimensions.

Contact between the elements of tribomechanical systems can be achieved in several ways. In this case, the contact is made in the line. This means that a contact is made between the front surface of the pin and the circumferential surface of the disk, which is visible in the cutting fluid (wear particles) and on the front surface of the pin. There is a direct proportionality between the amount of wear particles and the PQ index. The higher the PQ index, the better the disk material is machined if the wear path on the pin is smaller. During this test, two wear parameters were measured. The PQ index was measured at PQ 2000, and the wear strips (surface profilometer) Talysurf No. 6 and tool microscope.

During the test, an attempt was made to define the processing quality values of a group of isothermally improved ductile iron in contact with steels by measuring the PQ index in cutting fluids at the end of 120 minutes of tribological contact on a Pin on disk tribometer.

The normal load is for the value of the radial component of the cutting force at the tool load as pina and sliding speeds which are harmonized with the cutting speed of 0.65 m / s.

Key words: wear, isothermal ductile iron, high speed steel, wear traces, wear particles, PQ quantifier.

MODELING OF MACHINABILITY PARAMETERS OF HIGH ALLOYED CAST IRON DURING SURFACE GRINDINGPROCESS

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Abstract: High-chromium cast irons are used as abrasion resistant materials. Their wear resistance depends on quantity of carbides and the matrix supporting these carbides. The paper presents the results of cast irons of chemical composition (in wt. %) 19–22 Cr and 2–4.5 C alloyed by 1.7 Mo + 5 Ni + 2 Mn to improve their toughness, which were tested in working conditions of ferroalloys crushing. The paper also examines the machinability of surface grinding, where the tangential and radial component of the cutting forces are the function of the cutting elements as the output characteristic of the process. The elements of the cutting regime were the cutting depth, the feed movement speed and the lateral shift. For modeling was used 3 factorial model plan of experimental design and neural network.

Key words: cutting force, cast irons, grinding, mathematical model, neural network.

PRODUCTION REQUIRES AN APPRECIATION OF THE PHYSICAL AND CHEMICAL CHARACTERISTICS OF THE MATERIAL FOR MACHINING

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Abstract: Quality and characteristics of a material are important factor for success ful manufacturing. Quality control of the material at the beginning of a production process is usually based on mechanical characteristics control and rarely on identification of structure and chemical composition. Measurement of tribological characteristics of materials (anti-frictionaland anti-wear) and their abrasive resistance is stillnotperformedinour country. This paper presents there sultsoftri bological properties assesment of specific group of materials [2].

Scrack test consists in the application of a special device that allows increasing the load force by changing the sample carrier at a constant speed. In doing so, a diagrammatic dependence of the load forces-friction forces is formed. Tribo metarblock on study was successfully done. Electrical discharge machining (EDM) is a material removal procedure which can be used to machine all electroconduc-

tive materials regardless on their physical-metalurgical properties. But not all electroconductive materials are machined equally efficiently so each of the mhasits own characteristic EDM machinability. As an indicator can be taken differentcriteria such as: erosion speed, quality of machined surface, wear of electrode-part, specific energy consumption etc.

Key words: Residual stresses, quenching, Sachboring technique, resistance strain gauges, tempering.

CUTTING PARAMETERS OF MATERIAL IDENTIFICATION USING THE MULTI-INPUTS-MULTI-OUTPUTS FUZZY INFERENCE SYSTEM

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Abstract: This paper proposes a method for cutting parameters identification using the multi-inputs-multi-outputs fuzzy inference system (MIMO-FIS). The fuzzy inference system (FIS) was used to identify the initial values for cutting parameters (cutting speed, feed rate and depth of cut) and flank wear using cutting temperature and tool life as outputs. The objective was to determine the influence of cutting parameters on cutting temperature and tool life. The model for determining the cutting temperature and tool life of steel AISI 1060 was trained (design rules) and tested by using the experimental data. The average deviation of the testing data for tool life was 11/6 %, while that of the cutting temperature was 3/28 %. The parameters used in these testing data were different from the data collected for the design rules. The test results showed that the proposed MIMO-FIS model can be used successfully for machinability data selection. The effect of parameters and their interactions in machining is analyzed in detail and presented in this study

In the paper was carried out modeling of cutting parameters in face milling process of Semi Solid Metal alloys as well. As input parameters in the process of modeling were taken: cutting speed v, the feed per tooth and cutting depth, while for the output characteristics of the process were arithmetic mean surface roughness R_a and maximum roughness R_{max}. Modeling was done in two ways. The first model was made with the help of mathematical and statistical methods factorial experiment DoE, where it was used without mutual influence of model parameters.

The second model was made by artificial intelligence and as a tool is chosen neural networks.

Key words*:* cutting parameters, multy input multy output fuzzy interference system, semi solid metal, modelling, factorial plan experiments.

USED BATTERIES AND ACCUMULATORS RECYCLING

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Abstract: Acid lead batteries, also known as starter accumulators, are used as an energy supply for starter motors. Their lifetime is limited by incorrect use and lack of maintenance.

The accumulator consists of cells connected with each other to form a battery. The cells contain electrodes, separators and an electrolyte. On the positively charged electrodes (e.g. plates) the activator is PbO_2. On the negatively charged electrodes the activator is mycotic lead. The separators impede the mechanical contact between the electrodes. The electrolyte dilutes the concentrated sulphuric acid, H_2SO_4 (the so-called accumulator acid) to a concentration of 1,285 kg/m^3. Content of materials is next: Pb metals 28%, accumulator acid 25%, $PbSO_4$ 20%, PbO_x 15%, ebonite separators, polypropylene 12%

The measure of the accumulator "recycling rate" is the percentage of accumulators that have been recycled out of all discarded accumulators in a particular year. In developed western countries the official rate is between 75 % and 95 %, and is often supported by non-market means, such as "recycling fees". This method means that the buyer pays part of the total costs of the future ecological recycling of the product. The first country to introduce such a recycling fee was Sweden. In the early years of the fee, the rate of return of accumulators was almost 100 %. When the authorities realized that the return rate was not falling, they discovered that some of the "merchants" were importing used accumulators from neighbouring countries in order to claim the recycling fee.

The growing number of used lead accumulators is becoming one of the most pressing environmental problems in Slovakia as well as elsewhere. Used accumulators are considered as a dangerous waste from the point of view of waste laws, both in Slovakia and abroad, but at the same time they represent an interesting raw material source. There are several authorized companies which deal with the recovery and destruction of used batteries, and in Slovakia used accumulators can be left in waste collection areas.

Key words: used batteries and accumulators, collection recycling, environmental protection, dangerous waste.

OPTIMIZATION OF ELECTROCHEMCAL DEPOSITION OF Zn-Mn-Al2O3 COMPOSITE COATINGS

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Abstract: In this work Zn-Mn-Al2O3 composite coatings electrodeposited on steel were studied. The influence of Zn2+/Mn2+ ion ratio in the plating solution (1:1, 1:2 and 2:1), deposition current density (1-4 A dm–2), size of alumina particles (300 nm and 10 μm) and type of agitation (magnetic stirring and ultrasound) on morphology and corrosion stability were examined and compared. Composite coatings were deposited from additive-free chloride-based plating baths. In order to avoid agglomeration after alumina addition in the plating baths, the suspension was intensively agitated by a magnetic stirrer (200 rpm) for at least 2 h at room temperature before the codeposition experiments and during deposition either magnetic stirring (200 rpm) or ultrasound (38.7 W cm3 power) were used. The corrosion behaviour of Zn-Mn-Al2O3 composite coatings electrodposited at different parameters was evaluated by polaryzation measurements and electrochemical impedance spectroscopy in 3% NaCl solution. Morphology and chemical content was determined by SEM-EDS measurements. The high current efficiency of over 90% was achieved in all plating solutions containing 10 μm particles. The highest amount of Mn and Al2O3 were incorporated in composite alloy deposited from solution with Zn2+/Mn2+ ion ratio of 1:1. These coatings also showed homogenous morphology and greatest corrosion stability so they were chosen for further analysis of the influence of particle size and stirring type. Incorporation of 300 nm alumina particles in plating bath resulted in higher amounts of both Mn and Al2O3

in composite coatings. In addition, more homogenous coatings morphology and improved corrosion stability were obtained, with most optimal deposition current density of 4 A dm–2. Current efficiency remained high when magnetic stirring was used for agitation and somewhat dropped upon utilization of ultrasound. However, the composite coatings deposited with mechanical stirring also showed a high degree of agglomeration of alumina particles on top of the coating. In contrast, the uniform particles distribution was achieved by using ultrasonic agitation. Besides, considerable higher corrosion resistance was achieved by ultrasound assisted electrodeposition. Based on all results the highest corrosion stability, determined by both the smallest corrosion current density and the greatest low frequency impedance modulus values, were obtained by deposition from bath with 300 nm particles at current density of 4 A dm–2 and deposited with ultrasound aggitation.

Key words: composite coatings, electrodeposition, Al2O3, Zn-Mn, corrosion.

INVESTIGATION OF BENZOPHENONE-3 ELECTROCHEMICAL DEGRADATION ON TITANIUM ELECTRODE

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Abstract: Benzophenone-3 is a well-known molecular UV filter found mainly in commercial cosmetic preparation for sunscreen and skincare. Due to the increased use of sunscreens, it could be found in surface water and wastewater, which could affect the water quality and human health. Research indicates that benzophenone-3 act as endocrine disruptor and has a carcinogenic and mutagenic effect on humans and other living organisms. As such, poses a health risk to all living beings and need to be removed from the environment. Electrochemical techniques for wastewater treatment of organic pollutants show advantages over commercial techniques as practicality, safety, and simple application on both small and large systems. The presented research aims to examine the possibility of using titanium anode plates for electrochemical degradation of benzophenone-3 in 0.05 M aqueous sodium chloride solution. Electrolysis was performed in galvanostatic mode at a current density of 25 mA cm-2. During 40 minutes of electrolysis, the degradation efficiency of benzophenone-3 is 98.3%. Additional studies of process kinetics show that degradation of benzophenone-3 follows first-order kinetics.

Key words: benzophenone-3; electrochemical degradation; titanium electrode.

INFLUENCE OF ZINC OXIDE ON THE ELECTRICAL CONDUCTIVITY OF PRINTED ANTIMICROBIAL FABRICS

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Abstract: Linen fabrics are printed on a screen printing semi-automatic machine S-300. The printing is done with a modified alginate pasta with addition of Pinus sylvestris L. alcohol extract and zinc oxide. The antimicrobial activity of printed linen fabrics against Escherichia coli, Staphylococcus aureus and Candida albicans are examined. Antimicrobial activity against S. aureus is observed in samples printed with alginate pasta modified with Pinus sylvestris L. Electrical conductivity is measured using a HAMEG LCR bridge in the frequency range from 24 Hz to 125 kHz at room temperature. The main result of this study is that the addition of zinc oxide to the alginate paste of printed linen fabrics shows an increase in the electrical conductivity as well as antimicrobial activity against S. aureus.

Key words: Antimicrobial linen fabrics, Electrical conductivity, Dielectric properties, Fabrics, Herbal extract of Pinus sylvestris L, Zinc oxide.

THE INFLUENCE OF ADDITIVE CONCENTRACION ON QUALITY OF WHITE ALUMINIUM TRIHYDRATE

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Abstract: Alumina is product which can be produced in several ways, whereby different quality can be derived. Although it is very complicated, Bayer process is most abundant because it gives alumina with very good quality. Depending of aluminum tri-hydrate type which has to be produced, solution is treated ie not treated with appropriate additive, and later crystallization condition determines other properties and usage of alumina. In this research, as well as the title hints, effect of additive for whiteness is examined on quality of derived aluminium

hydroxide. Under that, effect of concentracion of additive, and mixing time, is included. Also, by reviewing literature and practical alumina plant approach "Alumina" d.o.o., conditions of decomposition of sodium aluminate is processed as well as it's effects on product quality. All of the experiments is performed in research and central laboratory of alumina plant and derived results is compared with ones from industrial conditions. Derived results can be used to accelerate further science-research work on this theme as well as the energy efficiency and quality improvement.

Key words: Alumina, additive, Bayjer process, crystallization, sodium aluminate.

FEATURES OF IMPLEMENTATION OF ARTIFICIAL INTELLIGENCE IN MACHINE-BUILDING PRODUCTION

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Abstract: The paper shows that technology and manufacturing are the sectors with the greatest potential for transformation through artificial intelligence. The use of artificial intelligence to process projects can dramatically increase the number and significantly improve the quality of production through digital analysis of market demand from the environment. The information system can act as a formalized tool for methodological support of the continuous process of improving the properties of the network production system. Artificial intelligence in modern companies can increase productivity and reduce production losses by more accurately forecasting the necessary parameters of production. The most general critical challenges of transformation of the information and communication nature of management of modern production systems are revealed. Digital duplicates of equipment and processes allow to make decisions taking into account all operating factors on the basis of fuzzy parameters. It is established that to create digital duplicates it is necessary to combine such technologies as system modeling based on wave physical processes and machine learning. Innovative activity at different levels leads to a sharp increase in the intensification and speed of interaction between its participants, as well as to the creation of relevant at a certain time for consumers products and services of the required quality and quantity, exceeding customer expectations through the use of artificial intelligence. However, the role of artificial intelligence systems in innovation in a plurality of subjects with hete-

rogeneous systems for determining the purpose and motives of behavior, inaccuracy and dynamism of their goals and objectives is insufficiently studied.

The development and widespread use of artificial intelligence in production processes, changes the usual idea of human functions. Changing the nature of work in production systems using artificial intelligence will affect all employees of all skill levels. This in turn will have profound implications for the structure of the workplace and the organization of work. Therefore, the paper provides a list of tasks for the introduction of artificial intelligence in modern engineering. Now cyber-physical systems provide such intellectual spheres of production as autonomous works, augmented reality, augmented production, vertical and horizontal integration, implementation of principles of intersectoral integration of artificial intelligence systems in various scientific fields, from natural and exact sciences to humanities. Given the available intellectual potential, in the near future Ukraine may become a regional leader in these areas, providing comprehensive and high-tech engineering services.

Key words: artificial intelligence, mechanical engineering, digital production, cyber-physical systems, production automation, innovation.

INFLUENCE OF GEOLOGICAL PARAMETERS ON THE CONCENTRATION OF INDOR RADON IN THE CITY OF TREBINJE

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Abstract: The paper deals with the analysis of the indoor radon concentration results measured in four schools of Trebinje city and taking into consideration their geological background and its characteristics. There have been 13 measurements and the results showed the range of 75 Bq/m3 to 4244 Bq/m3. Some of the indoor radon concentrations were very high, up to 15 times higher than recommended ones reaching the level of 300 Bq/m3.

In each of the four schools there are spots with the high geogenic potential and, 38 % results show a concentration higher than 1100 Bq/m3, which further

characterize this area as Radon Priority Area. From the geological point of view, the geological list Trebinje represents a part of Mesozoic and Paleogenic complex which build the outdoor Dinaride part. There are also different varieties of calcium carbonate and dolomite areas with sporadical occurrence of sandstones (pescari) and marlstones (laporci) accumulated at the end of the Paleogene period so that lithological content is pretty simple.

The main part of the terrain is represented by sediments originated from Mesozoic and Paleogenic structures which appear along with greater dislocation in narrow strings.

Key words: radon, radon concentration, Cr – 39 detectors, limestone, dolomite, dislocations.

MEASUREMENT OF RADON LEVELS IN AIR USING THE PASSIVE METHOD BASED ON THE ELECTRET TECHNIQUE AND THE ACTIVE METHOD BASED ON THE DEVICE RAD7

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Abstract: This study presentsthe measurement of radon levels in the air using two different methods and techniques. The research aims to explore their mutual advantages and disadvantages.

A passive integrated radon measurement method is based on an E-PERM® system consisting of type ST electret for short-term measurements, type S chamber and SPER-1A voltage reader, manufactured by Rad Elec Inc, USA.

The RAD7 device from Durridge Company, USA, was used for the active method measurements.

The measurement results were processed using the statistical packages Originv9 and SPSSv23. The obtained results were compared with the results of other studies.

Key words: electret, radon, ionisation chamber, passive method, activemethod.

HEISENBER FERROMAGNETIC BILAYER WITH DIPOLAR INTERACTION

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Abstract: The paper analysed a bilayer consisting of two isotropic Heisenberg antiferromagnetic monolayers coupled by a effective exchange and the dipolar interactions. We obtain the spin double-time Green's functions in the random-phase approximation and therefrom we determined the ebergy of elementary excitations in the system. We also calculated the critical temperature and mean velue spin at apsolutezero temperature. We analyzed those quantites as a function of the alternating exchange and dipolar interaction parameter.

Key words: Heisenberg antifferomagnet, bilayer, exchange and dipolar interaction, Green's function, random phase approximation, critical temperature.

EFFECT OF MIXING APPROACH ON THE PROPERTIES OF CONCRETE WITH DIFFERENT AGGREGATE TYPES

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Abstract: The subject of the experimental tests presented in the paper is the influence of the mixing method on the physical-mechanical properties of fine-grained concrete with the nominally largest aggregate grain of 8 mm. Concretes with three different aggregate compositions (river, crushed and mixture with coarse recycled aggregate) were mixed by the usual, and then by two-stage mixing approach (TSMA). Slump and flow, density and temperature were tested on fresh concrete. The compressive strength, flexural, splitting tensile strength, density, ultrasonic pulse velocity and water absorption were recorded on hardened concrete. Concretes prepared using recycled aggregate, according to all the mentioned tests,

can be used as an adequate replacement for concretes prepared using river or crushed aggregate, while the two-phase approach had the greatest effect on the increase of the splitting tensile strength.

Key words: recycled aggregate, concrete, two-phase mixing, properties of concrete.

MODELING FORMALISMS AND EXPERIMENT IN THE APPROACH OF LASER BEAM INTERACTION WITH MATERIAL AND APPLICATION

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Abstract: Depending on the type of material and the dynamic mode of the selected operating regime of the quantum generators-lasers, there are many different classified approaches from different areas of the standard type or specific / phenomenological approaches or approximately derived fast formulas. In the paper, first part deals with analysis, the second part with experiments and the third part with selected simulations on different materials. There is still a lack of results in the literature, both on known and modern materials / new laboratory types . A lot of detailed models are covered by computer support, so part of the paper deals with selected software support. The obtained results of the interaction show the quantifications of the interaction and the selection of more important parameters.The repeatibility and interpretation demand particular discussion. The analyses rely on developed formalisms, and on attempts where analogies with the main outputs are related to various material properties and measurable parameters.

Key words: modeling, lasers, materials.

HAZARD ANALYSIS OF THE DIRECT BIOPOLYMERS APPLICATION IN FOOD

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Abstract: Research in food science is increasingly focusing on the use of biopolymers in areas such as active packaging and encapsulation of additives. Food packaging provides a wide range of functions that protect the food nutrition and the integrity of the supply chain. However, a potential hazard to human health is the use of components and substances in the manufacture of these polymers that can migrate from packaging to food upon contact. The most common sources of commercially usable bioactive monomers are residues from agri-food production and by-products. Nano-sized or nanostructured materials are often used to improve the mechanical and physical properties of these materials such as permeability to moisture and gases, antimicrobial or antioxidant capabilities, and other applications for the production of active and intelligent packaging. The properties of biopolymers, such as the biodegradability in the product, can lead to additional sources of risk not observed in fossil fuel-based plastics. A special problem is posed by chronic risks, which primarily relate to the presence of allergens, biotoxins, nanomaterials and process contaminants. A small number of studies have so far dealt more seriously with these problems, and recent research has focused on improving the characteristics and technological properties of biopolymers that are comparable to fossil fuels polymers. Therefore, the aim of this study was to analyze the hazards posed by the use of biopolymer materials in direct contact with food.

Key words: Biopolymers, food, food packaging, risk analysis.

THE INFLUENCE OF COLD ATMOSPHERIC PLASMA ON GLIADINS EXTRACTED FROM GLUTEN FREE FLOUR

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Abstract: Cold atmospheric plasma has a significant place in the food industry. Considering that the number of people who are allergic to gluten is increasing and that a gluten free diet is increasingly used, the aim of this paper was to examine the influence of cold atmospheric plasma on gliadins extracted from gluten free flour. Samples of gluten free flour in the solid state have been treated with cold atmospheric plasma for 4 min, followed by extraction of gliadins with 70% (v/v) ethanol. Also, previously prepared gliadin extracts have been treated with cold plasma for 1 min. After cold plasma treatment, the samples were chromatographically separated on RP-HPLC chromatogram (Agilent Technologies Infinity), at two wavelenghts, 210 and 280 nm. The total number of gliadin proteins, the number of proteins within the fractions as well as their relative concentrations have been determined. Based on the obtained results, at a wavelenghts of 210 nm, the lowest number of proteins has been observed in the samples treated as extracts, and at a wavelenghts of 280 nm, the lowest number of proteins has been observed in the samples treated in the solid state. By treating gliadin from gluten free flour samples, the total number of proteins is reduced, compared to untreated samples.
Key words: Cold atmospheric plasma, gliadins, gluten free flour.

APPLICATION OF A NON-THERMAL PLASMA SOURCE FOR FLOUR DETOXIFICATION

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Abstract: Non-thermal plasmas (NTP) have been employed in many processes in order to modify surfaces of different materials, either as an etching tool, for surface activation and also for deposition of thin films and nanofabrication. In these applications mostly NTP at low-pressures have been used. Mostly usage of low-pressure NTP for these applications imposed a limitation to the type of material that could be treated and limited applications of technology to only on relatively dry materials. As NTP sources at atmospheric pressure are being developed, the number of plasma material processing applications is increasing. New fields for possible applications of NTP under atmospheric pressure sources emerge, such as medicine, biology and in the last years agriculture and food industry. NTP treatment can change the functionality and improve the rheological properties of food materials due to the radicals and ozone propagated oxidation of food compo-

nents. Additionally, plasma-created reactive species have demonstrated the ability for toxins detoxification. Therefore, in this study, we investigated the effects of NTP treatments on mycotoxins of contaminated flour and demonstrate that the reduction of mycotoxins content in treated flour is depending on the type of the toxin and treatment conditions. The results of these determinations indicated a marked decrease of mycotoxins content, possibly through a reaction of mycotoxins ozonization.

Key words: Non-thermal plasmas, food, mycotoxins, flour.

ISO STANDARDS AND ACHIEVING THE GOALS OF SUSTAINABLE DEVELOPMENT

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Abstract: The pursuit of faster industrial development and poverty reduction in the world, on the one hand, and the fear of exploiting natural resources and endangering the planet Earth, on the other hand, have influenced the emergence of more ideas on how to harmonize these processes. One of globally accepted the solutions is summarized in a process defined as sustainable development. Sustainable development has become an imperative for most human activities. The formal form of the process was given in the 2030 Agenda for Sustainable Development, which was adopted by all members of the United Nations in 2015. 17 goals have been set, which need to be reached by 2030.

International ISO standards affect the organization and efficiency of processes in production and service organizations. Several ISO standards contain requirements that are compatible with the goals of sustainable development. Since the same or similar indicators are used, the question arises to what extent implementation ISO standards contributes to the achievement of sustainable development goals.

Based on data on the number of organizations in 10 Balkan countries, which in the period 2007-2019 certified ISO standards, the authors analyzed the contribution of the application of standards ISO 9001, ISO 14001, ISO 22000, ISO 13485 to achieving the goals of sustainable development (SDG Index). ISO data, United Nations - Department of Economic and Social Affairs data and data from other relevant sources were used during the analysis. Based on the above data using statistical techniques to investigate the links between variables, the impact of the number of applied certified standards (4 ISO standards) and indicators for monitor-

ing the progress of sustainable development through the achievement of goal 3 (good health and well-being - 15 indicators), of goal 9 infrastructure - 9 indicators) and of goal 13 (climate change prevention - 3 indicators) of sustainable development was determined in 10 Balkan countries.

Key words: ISO standards, goals of sustainable development.

APPLICATION OF POLYURETHANE SYSTEMS FOR CONTROLLED RELEASE OF AGROCHEMICALS

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Abstract: With the growth of the global human population, the demand for agricultural products has increased. The increased yield is a result of the application of agrochemicals and advanced technologies. Excessive use of agrochemicals leads to environmental pollution and endangering human health, so more and more attention is focused on the proper and controlled cultivation of crops in agriculture. In this work, three types of polyurethane hydrogels were synthesized and the structure was examined by Fourier transform (FTIR) infrared spectroscopy, differential scanning calorimetry (DSC), swelling rate and plant culture growth with and without hydrogels on tomato crop culture were monitored. Fertilizers are water-soluble systems that hydrogels can absorb and later release into the soil along with water. The results of monitoring the crop showed that the application of hydrogels with controlled release of fertilizers has an extremely favorable effect on the tomato crop.

Key words: hydrogel, controlled release, agrochemical.

CONNECTING SECONDARY MEMORIES IN RAID 0 AND RAID 1 ARRAY

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Abstract: By connecting several secondary memory devices to one logical device, it is done by applying one of the seven ways of connecting to a RAID array. The primary goal of such connectivity is to increase performance as well as provide redundancy. The paper discusses two ways of connecting to a RAID array, namely RAID 0 and RAID 1. Different technologies for the production of secondary memory devices (HDD, SSD) and their use gives us different advantages, but also different disadvantages of such a way of connecting.
Key words: performance, HDD, SSD, RAID 0, RAID 1, RAID.

INFLUENCE OF SU SIZE ON RAID 10 PERFORMANCE WITH 4 SSDS

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Abstract: The performance of secondary memories depends on several parameters, the most important of which are the workload, the depth of the queue (QD, Queue Depth), and in the case of arrays of paired disks (RAID, Redundant Array of Independent Disks) the number of devices and the size of the data block, a strip unit (SU, Stripe Unit,). The size of a data block significantly affects the performance of secondary memory with magnetic disks (HDD). The same is true when realizing RAID 10 arrays of paired HDDs, so the size of the tape unit is selected based on several parameters depending on the purpose of the secondary memory. SSD (Solid State Trees) devices are technologically and fundamentally completely different from HDDs. SSDs are semiconductor devices with random access, so it is possible to expect that the influence of some parameters such as a size of stripe unit will be different compared to HDD. In this paper, the influence of the tape unit size on the performance of a RAID 10 array with 4 paired SSD devices is analyzed.
Key words: Performance, Stripe Unit (SU), HDD, SSD, RAID 10.

REVIEW OF COATING PROCESSES IN ORDER TO IMPROVE THE PERFORMANCE OF HYDRAULIC PUMPS

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Abstract: Coating processes are used to apply a very thin layer of material (coating) of a certain thickness to the base material, which changes its dimensions and characteristics. They significantly improve the physical, chemical, mechanical, electrical and tribological characteristics of parts and complete systems, and can also serve as protection (eg against corrosion). The reliability and efficiency of devices exposed to this treatment, and thus complete systems, produces their service life, reduces energy loss, expressed by reduced friction, reduced maintenance costs, and thus overall downtime. Coating processes may be classified as follows: Vapor deposition (chemical vapor deposition – CVD and physical vapor deposition – PVD), Chemical and electrochemical techniques, Spraying, Roll-to-roll coating processes, Physical coating processes and etc. The paper gives an overview of the coating processes both in terms of the application process and the achieved hardness and depth of the applied layer. Recommendations for the choice of treatment methods, the quality of the treated surfaces as a comparative analysis of the costs of thermochemical treatment on the example of the basic parts of hydraulic pumps are also given.

Key words: Coating processes, chemical vapor deposition (CVD), physical vapor deposition (PVD), electrochemical processes (ECP), spraying.

NANOMATERIALS AS DRUG CARRIERS FOR CANCER THERAPY

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Abstract: Cancer is a leading cause of death and poor quality of life globally. Even though several strategies are developed to reduce death, chronic pain and improve the quality of life, there remains a shortfall in the adequacies of these cancer therapies. Among the cardinal steps towards ensuring optimal cancer treatment are early detection of cancer cells and drug application with high specificity to reduce toxicities. Nanotechnology has the potential to increase the selectivity and potential of chemical, physical, and biological approaches for eliciting cancer cell death while minimizing collateral toxicity to nonmalignant cells. Materials on the nanoscale are increasingly being targeted to cancer cells with great specificity through both active and passive targeting. The possibility of modifying nanomaterial carriers with more active components enables the delivery of various drugs. Therefore, nanomaterial drug carriers can be organized and optimized for site-specific chemotherapy, thermotherapy, photodynamic therapy, and radiotherapy. In this review recent literature that has broken new ground in the use of nanotechnology for cancer treatment with an emphasis on targeted drug delivery is summarized.

Key words: nanomaterials, cancer, drug carriers, therapy.

TISSUE TYPE DETERMINATION BASED ON HOUNSFIELD UNITS

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Abstract: In a transverse computed tomography (CT) image, each pixel corresponds to a specific shade of gray scale or a CT number expressed in Hounsfield units (HU). The CT image is actually a distribution of linear attenuation coefficients (LAC–μ) in the plane after reconstruction. HU values (normalized to water) in each pixel are defined as: $HU(CT_{number})=)=[(\mu_{tissue}-\mu_{water})/\mu_{water}]\cdot 1000$. It is known that LAC directly depends on the relative electron density (RED–normalized on water), the atomic number (Z) of the attenuation material and the quality (energy) of the photon beam (80 to 140 kVp at CT) obtained from the CT scanner. HU values, for the human body, are in the range from −790 for lungs (RED is 0.2), 0 for water (RED is 1), to +850 for dense bone (RED is 1.456), at X-ray tube voltage of 120 KV. There are several phantoms on the market that allow precise correlation of HU with RED for different tissues. The body of the phantom is usually

made of „plastic water“ with several alternating positions in which plugs (cylinders) of known RED and mass density can be placed. The CT conversion curve (HU = f (RED)), i.e. the conversion of the obtained HU into known values of RED or tissue density, allows us to determine with great reliability which type of tissue it is and whether it is a tumor or healthy tissue.

Key words: computed tomography, Hounsfield units, relative electron density, conversion curve.

BACTERIAL ADHESION ON DIFFERENT DENTAL MATERIAL SURFACES

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Abstract: In my presentation I will consider the bacterial adhesion on different dental material surfaces like amalgam, Chromasit, Cr-Co alloy, two types of ceramics, resin-based composite, Au-Pt alloy, and tooth. All surfaces were characterized by measuring surface roughness, surface hydrophobicity and zeta potential. We consider the adhesion of Streptococcus mutans which is a primary colonizing bacterium in the oral cavity and most important cause for caries. Bacteria attached to the dental surfaces were fixed and examined with a scanning electron microscopy. From micrographs the bacterial adhesion rate was determined. We showed that the bacterial adhesion rate on amalgam and Chromasit was extremely low. On contrary on both alloys and ceramics the bacterial adhesion rate increased substantially, the greater adhesion rate was measured on tooth surfaces.

Key words: Adhesion, S. mutans, dental materials.

PREVENTION OF ORAL INFECTIONS BY USING GOLD NANOPARTICLES

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Abstract: Microorganisms can cause numerous diseases in the oral cavity such as: periodontitis, periimplantitis, candidiasis, dental caries, pulpitis, and infections associated with wearing an orthodontic appliance. In the treatment of these diseases, various antimicrobial drugs are used, most often systemically applied. The consequence of unjustified and excessive use of antimicrobial drugs is the resistance of microorganisms to existing drugs, as well as the increased frequency of consequent fungal infections due to disturbed balance of the flora of the oral cavity. Also, conventional antimicrobial therapy has a time limited therapeutic effect.

Nanomaterials represent a new strategy for the prevention and treatment of oral infections. The use of antimicrobial nanoparticles in the inhibition of clinical pathogens is an interesting and new research area. Given their specific advantages, including lower acute toxicity, reduced adverse effects, prolonged therapeutic action, and the ability to overcome pathogen resistance, the use of nanoparticles as antimicrobials has been in focus in recent years. Recently, a structural modification of dental materials with nanoparticles has been proposed, which would exhibit antimicrobial activity against resistant strains of microorganisms. Advanced dental materials with nanoparticles would serve as a modern alternative to antibiotics. Gold nanoparticles are the material of choice because they have good stability, biocompatibility, antimicrobial activity and are easily modified.

Key words: oral infections, gold nanoparticles, nanomaterials, antimicrobial activity.

BIOMEDICAL NANOMATERIALS AS NANO-CARRIERS FOR TARGETED TRANSPORT AND DELIVERY OF DRUGS

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Abstract: The paper analyzes the possibilities for the use of specific properties of nanoscopic materials in nanomedicine. Numerous applications of modern nanomaterials in biomedicine are in full swing, but still mostly in the research or testing phase. Achieving the full momentum of nanomedicine is probably still a long way off, however, potential advances in sensory and imaging diagnostics, as well as the development of drug nanotechnology, have already begun to change the medical picture. Targeted drug delivery and the results of advances in pharmacogenetics realistically pave the way for more concepts in this research. Based on the results of previous research on nanoscopic crystal structures, the properties of nanocarrier model substances for targeted drug delivery will be presented.
Key words: Nanomaterials, nanomedicine, nanosystems for targeted transport and delivery of drugs.

COMPARISON OF DOSE VERIFICATION USING PORTAL DOSIMETRY AND ARCCHECK FOR VOLUMETRIC MODULATED ARC THERAPY

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Abstract: The aim of this study was to compare dose delivery of radiotherapy plans using Portal Dosimetry (Varian Medical Systems, Palo Alto, CA) and ArcCheck (SunNuclear, Florida) detector. Twenty modulated arc therapy (VMAT) plans were made in Eclipse Treatment Planing System (TPS). It is recommended to verify the dose delivery before treatment on the TrueBeam (Varian Medical Systems, Palo Alto, CA) accelerator to compare calculated dose on the TPS and delivered dose on the machine. Measurements were made using portal dosimetry (Amorphous silicon (a-Si)) and ArcCheck (diode) detector.
Key words: Portal Dosimetry, ArcCheck, dose delivery verification.

EVALUATION OF ENAMEL SURFACE USING EDI AND ESRS INDEX AFTER REMOVAL OF THE FIXED ORTHODONTIC APPLIANCE

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Abtsract: *Introduction*: After completion of therapy with fixed orthodontic appliances, it is necessary to remove the brackets and the remaining adhesive. The process of removing the brackets and adhesive can lead to iatrogenic damage of the enamel surface. The aim of this research was to make a visual assessment of the enamel surface after application of the Enamel Surface Rating System and Enamel Damage Index after application of the green stone for the removal of the adhesive remnants, after completion of therapy with fixed orthodontic appliances.

Material and Method: Within the research, 40 human premolars, extracted for orthodontic purposes, were collected. The bucak surface of all premolars was treated with 37% orthophosphoric acid and then the metal brackets were placed on 20 premolars. After removal of the brackets, the residual adhesive was removed with a green stone. A visual assessment of the damage to the enamel was performed by the application of the Enamel Surface Rating System and the Enamel Damage Index.

Results: The most commonly estimated score with EDI at the overall level was 1 (52.5%), while the most commonly estimated score by ESRS was 4 (35%). A statistically significant difference was observed between the examined groups.

Conclusion: Using the ESRS index and the EDI index, significant enamel damage was determined after the application of green pebbles in order to remove the remaining adhesive after the completion of therapy with fixed orthodontic appliances. As part of the protocol for removing the rest of the adhesive after removing the fixed orthodontic appliance, it is recommended that the green stone be used at the very beginning of the removal of the adhesive, while the instrument is away from the viewing surface.

Key words: fixed orthodontic applinaces, green stone, adhesive removal.

TREATMENT OF SKELETAL DISTAL BITE BY TWIN BLOCK APPLIANCE – CASE REPORT

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Abstract: *Aim*: The aim of this study was to present opportunity of treatment of skeletal distal bite during pubertal growth using Twin block as one of the functional orthodontic appliances.

Matherial and method: In this case was treated boy in the 12 years of chronological age and in CS3 stage of skeletal maturation. The patient had skeletal and dental Class II with the vertical type of facial growth. Orthodontic procedure was completed with Twin block appliance during 20 months of active treatment.

Results and conclusion: During treatment with Twin block appliance skeletal Class II was corrected in Class I (angle ANB was corrected from 7° to 4°). The type of facial growth has not been changed during treatment. Overjet before treatment was 13mm, but at the end of treatment 3.5mm, while overbite was reduced from 5.5mm to 3mm. After treatment, patient had stabile Class I occlusion. Now the patient is in the period of retention using mobile appliance in the upper jaw.

Key words: functional, orthodontics, twin, block, appliance, skeletal, distal, bite.

TREATMENT OF CROWDING BY FIXED MULTIBRACKET APPLIANCE

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Abstract: *Aim*: The aim of this study was to show the efficiency of fixed appliances in the treatment of crowding in the patient with permanent dentition.

Matherial and method: The girl at the age of 13 years with completed permanent dentition was treated in this case. The patient had bimaxillary retrognathism in skeletal Class I (ANB angle 4°), dental Class II, backward facial rotation (Bjork`s polygon 401°), increasing value of SpP/MP angle (28°) and moderate crowding in the upper and lower jaw (5mm). The plan of treatment was the extraction of both upper first premolars using upper and lower fixed appliances.

Results and conclusion: Treatment with fixed appliances lasted 25 months. At the end of treatment, the patient had stable occlusion in Class I on canines and Class II on first molars. Before treatment overjet and overbite were 7mm and 2mm, while after treatment both parameters were 2.5mm.

Key words: crowding, fixed appliances, camouflage.

WHAT INFLUENCES THE SELECTION OF TOOTHPASTE IN THE YOUNGEST POPULATION

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Abstract: Numerous studies confirm the view that the inclusion of fluoride in the composition of toothpaste in the early 70s of the twentieth century is the main reason for the mass decline in the prevalence of caries in developed countries. The minimum fluoride concentrations in toothpastes were 1000 ppm(0,1%). Due to fear of development of fluorosis, it was initially consideredthat it was not necessary to use toothpaste at all in children up to age of 2, and then the so called “childrentoothpastes” were introduced and intensively advertised with fluoride concentrations from 200 ppm to 700 ppm. The increase in early childhood caries, and indisputable evidencethat brushing teeth without fluoride does not have a great preventive effect,have changed previous protocols, so that for more than a decade the position of most international and national associations of pediatric dentists has been that even the youngest have1000 ppm fluoride in toothpastes. Fluorosis is prevented by applying small amounts of such toothpaste to a brush;ricegrain (up to age of 2) and pea grain (up to age of 6). In Serbia, such protocol was first proposed in 2008 by the Clinic for Pediatric and Preventive Dentistry (in accordancewith the

European Academy of Pediatric Dentistry-EAPD), according to which a toothpaste with 500 ppm was proposed for children up to age of 2, but this was later changed to 1000 ppm for all ages, especially when it comes to children with risk of caries.

The aim of this paper is to determine the extent to which the parents are familiar with the right selection of toothpastefor children up toage of 3 and how much dentists comply with the contemporary protocol in their recommendations to parents.

An online survey was conducted with 500 parents and dentists,using the app-*Pollsfor Pages,* whose links were applied to social networks or forwardedby e-mail.

The obtained results showed that 39% of parents choose toothpaste based on the recommendation of their dentist, 19,2% toothpaste with less fluoride, 10,6% toothpaste with 1000 ppm fluoride, 7,6% fluoride-free toothpaste, 6% based on taste and smell, 5,7% based on advertising,5,8% choose online, 4,9% do not use toothpaste at all at that age, and the rest according to the age indicated on the toothpaste.

The following answers were obtained in the dentist's survey: 41,9% recommends toothpaste to a certain risk, 25,9% toothpaste with less fluoride, 20,3% claim that toothpaste should not be used at all at that age, 9,3% toothpaste with 1000 ppm fluoride with smaller amounts on the brush, 2,3% recommends only fluoride-free toothpastes.

The obtained results show that only10,6% of parents know which paste to choose, while 39% rely on the dentist's recommendations. At the same time, there is confusion in the field of information andthat a worrying number of dentists(48,5%) are not familiar with modern protocols, which significantly reduces the prevention potentials. It is necessary to devote much more efforts to education on preventionand informing the profession of the accepted protocols.

Key words: Children toothpaste, fluorides. Early childhood caries, application of fluoride protocols.

MOLECULE AS AN INTEGRATIVE COMPONENT OF BIOPHYSICAL SYSTEMS

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Abstract: Due to the fact that the fields of complex bionanomaterials and molecular microelectronics are constantly expanding, there is a huge interest in bio and physical systems further integration. The idea of this paper is to consider a molecule as an integrative component of these two systems that are dissimilar, even though they are consisting of identical submicroparticles. Electrons intrinsic property, in living and nonliving systems, is their motion within a molecule, but also they are shifting as a part of a molecule that is moving. Furthermore, molecules, as well as biomolecules, are constituents of moving bacteria, thus, a molecule has a central role in connecting electron and microorganism levels. Adding the fact that Brownian motion is a joint property of electrons and microorganisms motion with its fractal similarity characteristics, we can establish mathematical functions in order to relate and more explicit describe these particles motion. Having in mind that a single bacterial cell comprises a couple of million molecules, we created, based on the experimental data, mathematical analytical forms for one molecule and for one bacteria, and in the next step we will try to interconnect them regarding molecule number ratio, what is the aim of our future research. This opens the possibility for integrating biophysical and condensed matter systems structures at the micro and nano scale, which is of substantial interest for further advanced and improved micro and nanoelectronic materials andtechnology development.

Key words: microorganisms; biomolecules; Brownian motion; fractals; biophysical systems.

SELECTED RESULTS AND MODELING OF THE APPLICATION OF LASER BEAMS IN DENTISTRY ON BIO AND PROSTHETIC MATERIALS

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Abstract: The interaction of lasers has branched out in many different directions, towards medicine, to the type of prosthetic materials, but also in relation to more generally accepted fundamental methods. Although in any model there is a tendency to assess the possible effects as closely as possible, especially in dentistry where it is a matter of surgical procedures, it is of interest to know the transformations of materials and obtain new chemical compounds that can be harmful to living organisms. This calls for strict adherence to dosimetric principles (primarily meaning laser dosimetry).

The paper shows the „useful" initiation of disintegration processes on selected materials (gradual removal of layers of bio or prosthetic materials / processes by separation, ejection and formation of dm/dE where m-mass and E- energy are delivered in defined spatial temporal r, t space, formed microstructures for classical and modern materials of interest in dentistry.

Key words: dentistry, modeling, lasers, materials.

USING THE WATER FOOTPRINT METHOD IN DETERMINING THE REQUIRED AMOUNTS OF WATER FOR THE POPULATION, INDUSTRY AND AGRICULTURE

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Abstract: The concept of Water Imprint is a relatively new approach in defining the required amounts of water in water management activities. By dividing the water footprint into blue, green and gray water footprints, the quantities of water that circulate through the various water management activities can be defined. But the concept has its drawbacks and ambiguities and it can not be applied equally to all geographical areas. Greater analysis of the climatic characteristics of certain areas is needed and inclusion of all factors of natural pollution related to air, soil and water pollution that have a great impact in determining the required amounts

of water necessary for the use of water supply to the population, industry and agriculture.

Key words: Water Footprint, Blue Footprint, Green Footprint, Gray Footprint, Water Pollution.

APPLICATION OF GIS APPLICATIONS IN BALANCING THE REQUIRED QUANTITIES OF WATER IN THE CATCHMENT AREAS AND THEIR MANAGEMENT FOR THE NEEDS OF THE WATER MANAGEMENT ACTIVITIES WITH EMPHASIS ON THE MANAGEMENT OF THE EXISTING WATER SUPPLY SYSTEMS

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Abstract: The application of GIS applications and other software solutions in the daily operation of water management systems are increasingly finding their application. The detailed application of the GIS application by integrating the software packages for hydraulic sizing of the water supply networks provides various possibilities for optimal management of the existing water supply systems and increasing the level of utilization of the already built water supply networks.

Key words: GIS application, Mathematical models, scada, optimal management of water supply systems.

ADVANTAGES AND DISADVANTAGES OF WASTEWATER TREATMENT PLANTS IN SMALL SETTLEMENTS

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Abstract: Reports on the status and treatment of wastewater, in smaller settlements, in Republic of Srpska are discouraging. The current situation is the result of inadequate activities of local governments, which usually do not have adequate

professional staff and other conditions for managing such investment activities. In such a situation, local governments do not accept the offered technologies and processes for municipal wastewater treatment, which often do not correspond to specific conditions in the field.

In the paper are elaborated methods of wastewater treatment of smaller settlements with unconventional technologies. Seven representatives of unconventional technologies are described: septic tanks, Imhoff`s sedimentation tank, lagoons, artificial swamp sistem of purification with oil, green filters of moss and processes with biofilm. Some of the technologies are described in more detail. An example of the application of unconventional technologies is given - the design of wastewater treatment plants for a small settlement. For each of these devices, are given retrospective view for operating and maintaining as wll as advantages and disadvantages which they possess.

The paper points to some important elements that are important for the beginning and managing of investment activities related to the preparation, design, construction and maintenance of wastewater treatment plants of smaller settlements.

Key words: wastewater, treatment, smaller settlements.

ENERGY EFFICIENT MATERIALS IN ORDER TO REDUCE ENERGY CONSUMPTION IN CONSTRUCTION

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Abstract: Buildings are large consumers of energy, so their impact on the environment is long and continuous and cannot be ignored. The energy consumed in buildings makes up about 48% of the total final consumption, and half of that in Serbia accounts for heating and cooling and is constantly increasing. For these reasons, the construction industry must include measures to increase energy efficiency through the active integration of innovations and their application on sites. The energy efficiency of a building depends on the thermal properties of its cladding, wall material, type of window and sealing of openings in the facade of the walls. The thermal properties of building materials depend on its composition and structure. In the last decade, innovative materials (natural and artificial) have been used that are able to retain heat and reduce heating and cooling costs, and are a good

alternative to traditional materials. The paper discusses the application of energy efficient materials in construction and their thermal properties, which enable the maintenance of optimal temperature in the interior in all weather conditions with lower energy consumption and less impact on the environment.

Key words: construction, energy efficient materials, thermal properties of materials, phase variable materials.

COMPARISON OF THE CARBON BLACK AND BIOCHAR IMPACT ON THE POWER CONSUMPTION DURING RUBBER MIXING

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Abstract: A great attention, from environmental point of view, has been directed toward reducing fossil fuel consumption and finding alternate, renewable sources of materials in the rubber industry. The dominant filler for rubber composites is carbon black (CB), the petroleum product, due to its exceptional reinforcement properties, purity and low cost. Recently, the major interest is made in replacement of CB with biochar because of its renewability and low cost. In order to compare CB and biochar impact on the power consumption of rubber mixer, two simultaneous experiments were conducted: standard CB and the biochar made from woody waste feedstock were blended as filler with natural rubber commercial mixture. The experiments were conducted with 0, 10, 20, 30, 40 and 50 phr of CB and biochar, separately. Power consumption of rubber mixer was the same (0.044 kWh) for both mixtures with 0, 10 and 20 phr, and then started to increase using the CB, compared to biochar. Natural rubber blend with 50 phr of CB made a power consumption of 0.051 kWh, while the same share of biochar made 0.046 kWh. In addition to all its advantages, using biochar can contribute towards reducing energy consumption.

Key words: biochar, carbon black, natural rubber, elastomer.

ECONOMIC ASPECTS OF APPLICATION OF CONTEMPORARY INFORMATION AND COMMUNICATION TECHNOLOGIES IN BUSINESS

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Abstract: The Internet, Information and Communication Technologies (ICT) and digital technologies are responsible for creating a new economy based on knowledge, creativity, information sharing and the use of these technologies for the development and marketing of new products and services. The Internet supports the development of new forms of organizations without borders, which do not depend on time and location. These changes stimulate globalization, and the application of these technologies is a prerequisite for successful international business. The aim of this paper is to look at the current way of doing business of most business systems through a theoretical analysis of the advantages and disadvantages of using the Internet and ICT, and thus point out the potential opportunities for further business improvement.

Key words: Internet, information and communication technologies, digital economy, e-business.

POSSIBILITIES OF USING BIOGAS FOR THE NEEDS OF COGENERATION AT THE LANDFILL "KULAGIĆ ADA" IN KRALJEVO

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Abstract: Waste management in Serbia is based on its disposal. The negative impact of landfill gas (LFG) on the environment can be significantly reduced through its collection, adequate processing and further use as fuel for cogeneration

of gas plants. Biomass energy that originates from municipal solid waste landfills is now used as an efficiently fuel from renewable energy sources.Biogas is produced by anaerobic treatment of the organic mass of municipal waste. Landfill gas generated as a result of anaerobic digestion of biomass in digesters of landfill plants is basically methane CH_4 (50-55%), carbon dioxide CO_2 (40 - 45%) and non-methane volatile compounds, nitrogen suboxide N_2O and nitrogen oxides NOx. This paper presents a model and defined quantities and composition of landfill gas at the landfill "Kulagića Ada" in Kraljevo. Based on the measurements performed on 10 biothorns of the landfill, a satisfactory percentage of methane of 56% in the landfill gas was established, and thus the possibility of its use as fuel in cogeneration engines.Using the software package „Ukraine LFG mod. v1" in Excel environment we received an hourly biogas production of 205 m^3/h as well as recommendations for the selection of the appropriate type and power of gas cogeneration engines.

Key words*:* landfill, municipal waste, fuel, landfill gas, cogeneration, biothorn, *IPCC.*

GENETIC ENGINEERING IN THE FUNCTION OF BIOLOGICAL WAR ON A GLOBAL SCALE AND ENVIRONMENTAL SAFETY MEASURES

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Abstract: Once (intentionally or unintentionally) released into the world, nuclear and chemical missiles and biological agents pose a global threat and long-term environmental contamination. The possibility of biological invasions or diversions - is a current topic today, in the 2-year "harassment" of the COVID-19 virus pandemic, which threatens the health of a large number of people around the world. In many countries of the world, especially in the last decades, there are diseases that did not exist before, some are reactivated, little is known about the bad ones, as is the case with the COVID-19 virus. Some of these diseases, especially during the war, occurred at unusual times and in different localities. It is logical to

assume that in the future, protagonists of the special war and potential aggressors will do the same, and would put those forces at the task of, among other things, the use of biological agents. In the postmodern setting, in the conditions of this cruel pandemic of the Corona virus, the "fate" of present and future society in the conditions of this crude globalization (it would seem) depends primarily on the overcoming of the mechanistic approach to reality and the design of the eco-security paradigm. Within the framework of sustainable development and sanitary and ecological protection, expert evaluation of existing projects in this field is necessary, by science (somewhat by profession) and top scientific staff of all fields. The fate of the present and future society depends on overcoming the mechanistic approach to reality and projecting the security paradigm, that is. sustainable development. Within the framework of sustainable development and sanitary-ecological protection, it is necessary to expertly evaluate the existing projects on this issue, by science (to some extent also the profession) and top scientific staff. Our goal is to point out the importance of the realization of the national security concept in emergency situations. We are proposing measures for the crisis headquarters and state bodies, which should be taken at the highest level, so that major biological tragedies do not happen to us.

Key words: genetic engineering, viruses, biological warfare, COVID-19, pandemic, diseases, eco-safety.