7th International Conference

INNOVATIVE (ECO-)TECHNOLOGY, ENTREPRENEURSHIP AND REGIONAL DEVELOPMENT (IECOTERD)

October 12, 2021

e-Book of Abstracts

KAUNAS
University of
Applied Sciences

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INTRODUCTION

Innovative (Eco-)Technology, Entrepreneurship and Regional Development (IECOTERD)

Advanced technologies are becoming more common in our daily lives, as a number of innovative solutions are applied in business, manufacturing and public sectors. Entrepreneurship fosters innovation, as a result new goods, services, and procedures are likely to emerge faster.

The fourth industrial revolution spread into all areas of industrial production. In addition, the implementation of green economy policy requires new attitudes. Therefore, the questions like how to make the economy sustainable? how to turn environmental challenges into opportunities? how to foster innovation in regions? and similar issues need to be addressed.

The annual conference invites the scholars, practitioners, experts from Europe and all around the world to discuss the issues of technological innovations, eco-innovations and technology-based entrepreneurship as drivers for economic growth and social change in regions. Exclusive attention is paid to ecological technologies and sustainable regional development.
This event is organized by Kaunas University of Applied Sciences in collaboration with the Manufacturing Innovation Valley (Lithuania).

Major topics of the Conference include:

- advanced technologies, smart cities and regions (in a line with economic, social, health and environmental transformations);
- (eco-) technological innovations (renewable energy, healthy nutrition, etc.) and change in a region;
- good practice of technology-based entrepreneurship.

On behalf of the IECOTERD Scientific Committee
Irma Spūdytė

INNOVATIVE (ECO-)TECHNOLOGY, ENTREPRENEURSHIP AND REGIONAL DEVELOPMENT (IECOTERD) VIRTUAL CONFERENCE PROGRAMME

09.00–10.00 **REGISTRATION**

10. 00–10.20 **Welcoming Address and Opening of the Conference**
Paulius Baltrušaitis, Director of Kaunas University of Applied Sciences, Lithuania

10.20–12.30 **Parallel Sessions**

12.30–13.30 **LUNCH**

13.30–14.00 **Manufacturing Innovations and Innovation Ecosystems for Start-ups**
Gintaras Vilda, Director of the Manufacturing Innovation Valley (Lithuania)

14.00–14.30 **How the combination of Circular Economy and Industry 4.0 can contribute towards achieving the Sustainable Development Goals**
prof. dr. Žaneta Stasiškienė, Kaunas University of Technology (Lithuania)

14.30–15.00 **Artificial Intelligence in the Urban Environment: Smart Cities**
Aleksandro Montanha, University of Sevilla (Spain)

15.00–15.30 **Sustainable Innovation in the Global Airline Industry: Lessons Learned for Cities and Regions**
prof. dr. Keith G. Debbage, The University of North Carolina at Greensboro (United States of America)

15.30–15.40 **COFFEE BREAK**

15.40–16.00 **FINAL SESSION**

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SPORT MANAGEMENT PROBLEMS IN POST INDUSTRIAL REGIONS ON THE EXAMPLE OF CITIES IN THE SILESIA PROVINCE

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Abstract

Relevance of the topic: Contemporary sport is a social and economic phenomenon. These two areas require special analysis in the process of managing the development of sport by city administrations. The restructuring of the region's economy and the closure of heavy industry companies are changing the methods of financing sports. The main aim of the research is to indicate the key problems of sport management by the city governments in the time of socio-economic changes in Poland for last 30 years, on the example of the one of the most industrialized regions in Europe e.g. Silesia province.

Methodology: To achieve this aim, the methods of literature analysis of the subject, reports on sport market and strategic documents of selected city administrations were used. The research focuses on cities where for many years sport was financed from the budgets of the largest companies (heavy industry companies).

Results: The author is aware of the limitations associated with this research and inference resulting from a small research sample and the dynamics of changes in the economy but the process of economic changes in the region is still strongly influencing the sport market. The involvement of public funds both from the city and the central administration seems necessary. Especially with regard to the maintenance of the existing sports infrastructure. Financing of sports clubs requires clear access criteria and transparency in decision-making processes. It is important to strategically plan the development of sport. The development ought to be understood not only as a numerical / quantitative growth, but also a qualitative one.

Conclusions & practical implications: The described and analyzed factors influencing the development of the sport market, in particular the management dilemmas during economic changes in Europe, can be used by local governments to effectively support the sport development market. The research is based on the analysis of former and still existing strategic documents which refer to sport management in the region. The theoretical concept of the development of the sport market in the time of industrial changes in Silesia province is also covered.

Keywords: economic changes, sport management, sport market, post-industrial regions.

CIRCULAR ECONOMY – THE OVERVIEW OF GOOD PRACTICE IN EUROPE

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Abstract

Relevance of the topic: The circular economy model is drawn from the natural environment, in which the waste of one organism becomes food for dozens of others, the waste of which in turn becomes food for others, etc. until the cycle is closed. In biological processes shaped over billions of years on our planet, the waste of one process becomes food or the raw material for other processes, closing the circle.
Actions taken at the national level are necessary due to the depletion of natural resources, and more importantly, changes in the environment that negatively affect human life and health. New business models, corresponding to the assumptions of the circular economy concept, result in the creation of new opportunities for enterprises. It is important to promote experiences and good practices in the development of circular economy at the national level.
The aim of the article is to review good practices and experiences of selected countries in the field of the circular economy, along with an indication of available sources of their financing.

Methodology: To achieve this goal, the desk research method was used, in which, on the basis of literature analysis, good practices in the field of circular economy were identified. The desk research is a part of the implementation of Intellectual Output 1 and 2 of the EnMind Erasmus+ Cooperation for innovation and the exchange of good practices project. The project covers the development of a Toolkit addressed to young people aiming to support and help those who want to start a social entrepreneurship.

Results: Examples of the implementation of the principles of the circular economy were presented, e.g. good practices of various companies, from small craftsmen processing waste into high-quality products, to large corporations changing the entire model of their business operations.

Conclusions & practical implications: Circular economy is a key element in the fight against the climate catastrophe, remodelling the economic system that led to it. It allows to significantly reduce greenhouse gas emissions, among others by limiting the extraction and processing of primary raw materials and the amount of waste that needs to be managed. The concept of a circular economy is a challenge, but at the same time a great opportunity for economic and social development.

Keywords: circular economy, enterprise management, Good Practices, EnMind, social entrepreneurship.

DOMESTIC TOURISM DEVELOPMENT IN REGIONS OF LATVIA UNDER CONDITIONS OF TRAVEL RESTRICTIONS INDUCED BY PANDEMIC

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Abstract

Relevance of the topic: Travel restrictions due to the global outbreak of COVID-19 coronavirus (SARS-CoV-2), caused economic damage to the tourism industry through the loss of income and social harm for society which was unable to travel for business or pleasure. In 2020, 61.6 % less foreign visitors visited Latvia compared to 2019. At the same time, the number of resident visitors at accommodation establishments has increased for some local destinations. The inter-regional travel flow between regions and local destinations is one of the critical hospitality industry indicators for local tourism. This study aims to explore the key indicators that describe the situation in the tourism sector of the regional context in Latvia in the period of 2020-2021, and to identify the main trends in the development of domestic tourism in the situation of high uncertainty.

Methodology: The research design encompasses an analytical, comparative and participatory approach. To achieve the goal of the research, the author has used the observation methods and statistical data analysis, using secondary sources. The comparative approach implies investigation and comparison of tourism development in regions of Latvia based on the comparison of the key industry indicators. The participatory approach implies joint development of new knowledge by researchers and local businesses. The data consists of participatory observations of media publications and qualitative interviews with local businesses.

Results: The results of the analysis show that the loss in domestic tourism is not homogeneous among the regions of Latvia. Domestic tourism emerges and develops in the local destinations of Latvia in conditions of travel restrictions. Domestic tourism products cover a large daytrip market, weekend trips, residents staying overnight in various types of accommodation. As a result, revenues from domestic tourism make a significant contribution to the local economy.

Conclusions & practical implications: The emergence of new products based on the convergence of industries and thematic types of tourism is observed, which shows the possibility of finding new niches for the development of potential tourism resources and the transformation of existing traditional tourism products or creation of new products for the local tourism market.

Keywords: domestic tourism, inbound tourism, region, tourism development, tourism product.

INDUSTRY 4.0 TECHNOLOGIES: BUSINESS OPPORTUNITIES & THREATS IN THE SHADOW OF THE ADVENT OF INDUSTRY 5.0

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Abstract

Relevance of the topic: The presentation aims to highlight the importance of new technologies for the business world and to emphasize some considerations especially due to the advent of industry 5.0

Methodology: Literature analysis.

Results: Industry 4.0 has a vast impact in the business world with a number of positive outcomes, while several considerations have arrived in terms of how SMEs will be able to handle it, especially since we are approaching to industry 5.0 which will change the workplaces globally at a high degree.

Conclusions & practical implications: The latest technologies will be able to change the workplaces and if corporations are able to cope with these changes, they will be able to positively impact, via their implementation, the whole world. Especially SMEs will face many difficulties which they will be able to overcome if they follow the right strategy.

Keywords: Industry 4.0, opportunities, small and medium-sized enterprises, industry 5.0. technology**.**

THE SERVICES COMPLEX OFFERED USING ICT IN SUSTAINABLE TOURISM DEVELOPMENT

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Abstract

Relevance of the topic: Walking is low in terms of the environmental impact of people who take part in it, as people are spending their time walking rather than other forms of transport, therefore encouraging wider sustainability goals. The walking routes include information about wider sustainability goals, such as the natural resources, make an emphasis on physical and mental health and include mindfulness activities for people to practice during the walks. The innovation of information management is the mobile application, along with additional information about walking routes, the local cuisine and recipes. The aim of the research is to determine the testing methods of walking routes development.

Methodology: The case study is based on defining walking routes and learning about sustainable tourism. Data for this research was collected using a multi-method research together with experiment and scientific analysis.

Results: A case of sustainable tourism that creates links between countries' cultural heritage and human health in two aspects: walking routes that are an exercise option and can also be a form of low-environmental impact travel and a heritage recipe book that also considers nutrition and sustainable food systems.

Conclusions & practical implications: An example of sustainable tourism, presenting the testing process of tourist routes, combining the learning about food production and sustainable food systems and how these can have a positive impact on people's health. The walking routes, the recipe book, and all the activities associated with the experiment will be uploaded to a mobile application and an online platform that people could access the information from anywhere.

Keywords: culture, ICT, walking routes, sustainable tourism.

SUSTAINABLE ECONOMIC DEVELOPMENT: NECESSITY AND BARRIERS

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Abstract

Relevance of the topic: The topic of sustainable economic development is increasingly being analyzed. There are many goals that cover sustainable development, such as a healthy environment, protection of the planet, prosperity and other goals. Despite the needs, there are many barriers that hinder this process. For this reason, the aim of this research is to review literature and provide the most important barriers as well as necessities for sustainable economic development.

Methodology: Literature review.

Results: Sustainable development means the development where meeting present needs does not reduce the ability for future generations to satisfy their own needs. The necessity for sustainable economic development is related to four main themes: economy (job creation, energy security, innovation, financing, etc.), equity (income distribution, distribution between and within countries, etc.), environment (sustainable use of resources, enhancement of natural resources, water and other natural resources, etc.), and constituents (partnerships between various sectors, participation of community in development decisions). However, despite the necessity, sustainable economic development faces barriers that can be described as related to four main themes: competition (conflict of interest, inter-regional competition, etc.), social (population growth, absence of changes in human behaviour, limited knowledge on sustainable development, etc.), poor monitoring (lack of special targets, lack of information available to decision-makers, etc.), and practice (incentive based practice, mismatch between what is publicly declared and what is practiced).

Conclusions & practical implications: Literature review revealed that there is a number of important reasons why sustainable development is necessary. Yet, there are many barriers that hinder sustainable development. This research has a practical meaning in terms of the main systematized information about the barriers and necessities of sustainable economic development.

Keywords: barriers, development, economic, necessity, sustainable.

CHANGES IN CROP STRUCTURE IN LITHUANIAN MUNICIPALITIES AND THEIR THREATS

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Abstract

Relevance of the topic: Soil is one of the main natural resources necessary for growing crops. In Lithuania, the area of both utilized agricultural land and crops is increasing. The structure of crops is changing rapidly. However, the counties and municipalities of the country vary greatly in soil quality and opportunities to grow the most suitable crops, and thus ensure the sustainable use of land resources. The research aim is to determine the tendencies of changes in the structure of crops used for biomass production in Lithuania.

Methodology: Peculiarities and dynamics of crop structure in 2003–2020 were analysed at the level of Lithuanian municipalities according to five groups of soil quality, classified by J. Mažvila, G. Staugaitis, Z. Vaišvila, P. Aleknavičius, A. Juozokas, R. Mockevičius and L. Lukšienė (2011). Land productivity assessment data, last updated on January 1, 2019, was used. Statistical data of Eurostat, OECD, Statistics Lithuania was used. Applied research methods: Statistical data analysis, induction and deduction.

Results: Long-term changes in crop structure were identified across the country and in municipal areas, classified according to the soil productivity score.

Conclusions & practical implications: Trends in crops structure show increasing ecological threats and negative environmental impact.

Keywords: changes, crop structure, threats.

INFLUENCE OF AGROBIOLOGICAL ADDITIVES ON SUSTAINABLE WATER USE IN AGRICULTURE

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Abstract

Relevance of the topic: Climatic conditions in Lithuania have been rapidly changing over the last 20 years and the signs of climate change in various regions differ. Estimating the amount of precipitation, a downward trend in the total amount of precipitation over the whole vegetation period is observed. The forecast until 2035, on average by 3.4%, and the forecasted air temperature increase, on average by 1.5-5.1 ° C. Such climatic changes cause threat to agriculture due to insufficient ensuring of soil moisture content for cultivated plants. As one of possible solutions currently the market offers soil moisture retention additives. To determine their efficiency, in-kind tests are performed in horticultural farms of different regions of Lithuania.

Methodology: Agrobiological additives were chosen for the sustainable use of water in agriculture, i. e. argroperlitis and agrovermiculitis, which in the spring of 2020 were poured and spread at different thicknesses (0.5; 1; 2 cm) in five Lithuanian horticultural farms, choosing a 5-acre test field in each farm. During the tests, volumetric water volume measurements were performed in May-August, every 10 days at a depth of 30 cm. Soil temperature was also recorded with three measurements in each test field. A TDR 150 device was used to measure the volume of water (%).

Results: In 2020, the temperature was close to the average perennial, the periods without precipitation were short, therefore it was not possible to record significant differences in soil moisture content (0.5-2.5%) using different rates of application of additives.

Conclusions & practical implications: During the field experiment, introduction of different rates of additives in five farms revealed that soil moisture content was not significantly higher in any of the farms than in the control field. The obtained results revealed that in the case of short dry periods the effect of the analyzed additives on soil moisture retention under field conditions was not pronounced. Also, if possible, it would be optimal to measure soil moisture on a daily basis, as it is likely that more significant differences in the water volume between the rates of added additives will be recorded.

Keywords: biological additives, water conservation.

FREQUENCY OF MICROSCOPIC FUNGI IN THE UPPER LAYER SOIL OF CONIFEROUS TREE STANDS

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Abstract

Relevance of the topic: Along with bacteria, fungi are important as decomposers in the soil food web. Fungi convert hard-to-digest organic material such as the cellulose and lignin into forms that other organisms can use. Microscopic saprophytic fungi are dominant in forest soil, there fungi community compositions differed within tree species and soil quality

Methodology: The present study was designed to examine frequency and prevalence of microscopic fungi in the top layer of mineral soil of native tree Pinus sylvestris L., Picea abies (L.) H. Karst. and alien tree Thuja occidentalis L. and Larix sibirica Lebed stands. Studies on fungi frequency conducted every two months (January, March, May, July, September and November) in 2019, prevalence of fungi genera – in March and May of 2021. Biochemical composition (N, P, Ca, lignin) of investigated tree litter was also rated.

Results: By the carbon and nitrogen (C: N) and lignin and nitrogen (Lig: N) ratios, the slowest decompositions were of the T. occidentalis litter and the fastest one of P. abies litter. Most abundant microscopic fungi were found in early spring (March) and late autumn (November) and the least one at the end of summer. The biggest frequency of microscopic fungi was in the soil of T. occidentalis and the least one in P. sylvestris stands. 21 fungi genus were found in the soil of investigated stands. The diversity of fungi genera was bigger in March. In May, the rise of temperature influenced the decline of some fungi genera and prevalence of others. Fungi of Penicillium, Geomyces, Mucor, Mortierella, Trichoderma genera were detected in the soil of all studied stands. The highest diversity of fungi genera was identified in the soil of P. sylvestris stand.

Conclusions & practical implications: The frequency and diversity of microscopic fungi in the upper layer of mineral soil of studied coniferous tree stands was influenced by biochemical composition of litter. The higher lignin and organic carbon content in litter positively affected a higher number and genera of microscopic fungi. The rate of number and prevalence of fungi and fungi genera was influenced by changes in temperature during tree vegetation.

Keywords: prevalence, native, alien, genera, diversity

INVESTIGATION OF THE DAMAGE CAUSED BY SPANISH SLUG (*ARION LUSITANICUS* MABILLE)

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Abstract

Relevance of the topic: The Spanish slug (*Arion lusitanicus* Mabille) is only one species of invasive animal native to the Spanish and Portuguese region of Lusitania. It was first detected in Lithuania in 2008 in Kaunas. The species is spreading rapidly, which creates unfavourable conditions for growing plants in gardens, parks and other areas. No similar studies have been performed in Lithuania. The study was conducted in the training garden of Vytautas Magnus University Botanical Garden to control their damage to buckwheat husk mulch. The aim of the research was to investigate the effectiveness of buckwheat husks as a natural plant waste in protecting garden plants from damage caused by Spanish slug.

Methodology: At the study sites, plants were mulched with dry, loose, and clean buckwheat husks of a 5 cm layer. The damage caused by the Lusitanian slugs was recorded by measuring damage on plant leaves and converting the damage into the percentage expression. The phytofixation method was used. Damage was assessed on a five-point scale, where 0 point - plants undamaged, 1 point - damaged up to 15%, 2 points - damaged from 15 to 30%, 3 points - damaged from 30 to 50%, 4 points - damaged from 50 to 75 percent, 5 points - damaged (destroyed) from 75 to 100 percent of leaves of the plants studied.

Results: The results of the study showed that the use of buckwheat husk partitions and mulching vegetables with them can control the damage of invasive slugs. Minor defects were found in vegetables mulched with buckwheat husks: damage from 1 to 2 points. In the control site, where the plants were not mulched with buckwheat husks, the damage was 3 points. Having assessed the damage done, it can be stated that the activity of Spanish slugs could also be affected by less favorable environmental conditions: sunny days, high ambient air temperature, limited rainfall and well-maitained environment, as there were no shady places and high grasslands or other shelters for slugs.

Conclusions & practical implications: During the study, the meteorological conditions were partly similar to those of perennials, which were moderately or slightly favorable to the activity and harmfulness of Spanish slug.

Keywords: Spanish slug, mulch, buckwheat hulls.

FACTORS INFLUENCING THE DEVELOPMENT OF ENTREPRENEURSHIP ON FARMER'S FARMS

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Abstract

Relevance of the topic: Theoretical analysis has shown that small farms prevail in Lithuania, which limits the economic growth of the agricultural sector. To become competitive, farmers need to increase production by modernising their production facilities, increasing productivity and labour efficiency. Therefore, it is essential to have the appropriate knowledge and skills (e.g. how to modernise production facilities, how to increase productivity, etc.). The lack of knowledge and skills hinders the development of new activities, that is why support is one of the tools farmers need in order to implement new ideas. The aim of the research is to identifying the factors affecting farmers' entrepreneurship, and to present measures to promote farmers' entrepreneurship.

Methodology: Theoretical research was carried out while applying methods of analysis and content analysis of scientific research. In order to find out the attitude of farmers to farming, motives and factors that affect farmers' entrepreneurship, the method of questionnaire survey was applied. In total, 108 farmers in Marijampole county were interviewed. The questionnaire survey was conducted from February to March 2021, online.

Results: The research showed that setting up a business (a farmer's farm) is not difficult, a majority of farmers inherited the farm from parents or other family members. Most respondents develop traditional agriculture that provides the market with raw materials and just a small number of farmers create a value-added product. Younger farmers are active consultants, they are interested in innovations trying to apply them in farming activities. However, the prevailing view is that performance is more influenced by external environmental factors. It is recognized that financial support measures are an important factor in business development, but often support is the goal, but not an incentive to implement ideas.

Conclusions & practical implications: Appropriate measures were proposed to increase the entrepreneurship of farmers: firstly, entrepreneurship education. These measures should be targeted at all farmers, in particular, at young start-ups farmers, owners of small farms, as the lack of new ideas. The traditions of farm business development in Lithuania hinder development and implementation of innovations. Secondly, creating favorable conditions for business development. This tool focuses on specialized information development of a system to facilitate access to information for farmers. Thirdly, good practice dissemination among farmers. This measure would help farmers to find ideas and take decisions on further business development.

Keywords: agriculture, farmer's farm, farmers' entrepreneurship.

ASSESSMENT OF GREEN PLANTATIONS CONDITION IN THE ENVIRONMENT OF THE FACULTY OF TECHNOLOGIES AT KAUNAS UNIVERSITY OF APPLIED SCIENCES

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Abstract

Relevance of the topic: The greenery on the university campus (Technology faculty of Kaunas University of Applied Sciences) is arranged for decorative and educational purposes. Green plantations serve as a high-quality training base for students studying agribusiness technologies. The topic is relevant as planting of imported plants in greeneries is currently becoming more popular, but meteorological conditions may be completely unsuitable for their growth. Imported plants can be destroyed by various pests and disease-causing agents. The novelty iof the research is to select various plant species and varieties, expanding the range of greeneries. The aim of the research is to assess the health of greeneries, contribute to the selection the most suitable plant species or cultivars taking into consideration our climatic conditions and provide recommendations to farmers.

Methodology: The methodology developed by V. Juronis and V. Snieškienė (1998) was used to examine the monitoring method. Diseases intensity and pest abundance were assessed using a point scale from 0 to 4, where 0 point indicates individual spots on the leaves, damaged up to 10% of the plant foliage; 1 point - damaged 11-30% of leaves, 2 points - damaged 31– 60% of leaves, 3 points - damaged 61-80% of leaves, 4 points - damaged more than 81% of the plant surface.

Results: From 2018 to 2021 the state of green plantations in the environment of the faculty was examined: woody plants in flower beds, in the park and in the training orchard. Phytosanitary state of 17 species of decorative woody plants as well as of 8 species and 9 cultivars of garden plants was assessed. Good meteorological conditions in the summer of 2018-2021 had a positive impact on the plants, subsequently, a majority of the plants examined were in a good state.

Conclusions & practical implications: From 2018 to 2021, during the study period, the meteorological conditions for the plants to grow were favorable, so most of the woody plants were in a good condition. The most damaged were Lodel cultivars apple trees (*Podosphaera leucotricha (Ell. Et Ev.) Salm*), the damage was 3 points, small-leaved linden brown spots (causative agent *Mycosphaerella millegrana)*, which damage amounted to 2 points. Small-leaved linden was the most severely damaged by pests: linden sawflies (*Caliroa annulipes*), abundance rated 1 point, gall mite (*Eriophyes leiosoma* (Nalepa)), abundance rated 2 points.

Keywords: environment of the faculty, decorative, plants, condition.

ACCEPTABILITY OF FRUIT PASTILLES FOR CONSUMERS AND COMPARISON OF THEIR ENERGY VALUE

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Abstract

Relevance of the topic: Replacement of traditional sweets with a high content of sugar with fruity pastilles. The aim of the research is to make healthy, consumer-friendly fruity pastilles using mostly local materials for ecological reasons and to promote entrepreneurship. For the production of these pastilles, only natural materials like fruits and vegetables were used. Food colouring or other artificial additives like sweeteners, etc. were eliminated. Different methods for production were used to make a range of healthier candies.

Methodology: Technological part of the research involved production of pastilles from dried fruit puree without added sugar in order to make an alternative for conventional sweets that have a high sugar content. For this reason, different types of fruits, berries and vegetables can be used to make puree. Also, some pastilles were made with added sugar to render a more intense sweet flavour. This sugar was added in much lower quantities in contrast to the food industry and will be an option for adults who prefer sweeter pastilles. A sensory analysis based on the questionnaire to evaluate the appearance, smell, taste, and texture of fruit pastilles was distributed among respondents of two age groups. Two special questionnaires were designed: one for adults, another, a simplified version, for children. To determine a calorific value of the pastilles a calorimetric bomb was used in the research.

Results: Fruit pastilles without added sugar and with a reduced sugar content were acceptable to consumers. The highest scores were given to the pastilles made from the apple species Golden Delicious and carrots. When sugar was used, a sticky surface on the fruity pastilles formed. It was found that the fruit pastilles had a lower sugar content in comparison to traditional sweets. It can be said that pastilles made from fruits and vegetables either with or without added sugar are healthier in terms of the amount of calories.

Conclusions & practical implications: The fruit pastilles are suitable for adults and children, as the caloric content is significantly lower than of traditional sweets.

Keywords: fruit pastilles, sensory analysis, calorific value.

EFFECT OF MILK POWDER ON THE TECHNOLOGICAL, RHEOLOGICAL AND SENSORY PROPERTIES OF YOGHURT

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Abstract

Relevance of the topic: High-protein yogurts have received increased recognition in recent years. As a result, this yogurt category has been fortified with milk protein concentrates, whey protein concentrates, and whey protein microparticles. The aim of this research was to evaluate the influence of different types of milk and whey powder on the rheological, sensory and technological properties of yogurt.

Methodology: Dry matter, pH, syneresis, viscosity tests and sensory evaluation

Results: Sensory studies of yoghurts with added milk and whey powders showed that the smell of added powders was most pronounced in sample A2 – (value 4) (yoghurt with vegetable fat-saturated milk powder) and least in sample A3 – (value 1) (yoghurt with skimmed milk powder). Flavours are related to the amount of fat in the product, so the powder that contained vegetable fat accentuated the smell of milk. The highest dry matter content was in yoghurt with the highest protein content: A1 yoghurt with whey protein concentrate 14.96%. The pH tests results showed the same dependence that the pH of the yoghurts decreases during storage depending on the composition of the powder added. The largest pH change was obtained in samples A1 and A4 - from 4.93 to 4.48 and - from 4.94 to 4.56, respectively. The results of syneresis studies showed that the longer the yogurts were stored, the higher the amount of whey released. This is due to the greater instability of the whole structure due to the decreasing pH. During storage of yoghurts, the viscosity decreased in all yoghurts in the following order: A3 ≥ A2 ≥ A1 after 6 days and A2 ≥ A3 ≥ A1 after 9 days. A1 yogurt containing whey protein concentrate had the lowest viscosity (570.49 cP).

Conclusions & practical implications: This study shows that skimmed milk powder added during the preparation of yoghurt gave the best results on the technological, rheological and sensory properties.

Keywords: yoghurt, milk powder, syneresis, viscosity.

APPLYING TRIZ-BASED METHOD TO IMPROVE CREATIVITY IN MOLECULAR GASTRONOMY

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Abstract

Relevance of the topic: The world of food is now facing the significant challenge of improving its innovation process during the development of new products. Resolving this challenge in molecular gastronomy requires improving the creative process of food technologists. This process often is associated with intuition and experience. However, creativity can be seen as a systematic process and various efforts have been made in the development of approaches towards this direction. For example, the complex disperse system (CDS) formalism. To contribute to this systematic idea of creativity, the theory of inventive problem solving (TRIZ) offers concepts, methods, and tools to enhance the problem-solving process and creativity.

Methodology: The author analyzed the existing case studies that described the use of methods and tools of TRIZ that can enhance creativity in molecular gastronomy. This analysis requires an evaluation of the existing TRIZ literature. Then, the interpretation and classification of the TRIZ examples by an expert. These examples function as a guide to stimulate creativity.

Results: This research reveals the viability of applying the TRIZ theory in molecular gastronomy. The analysis offers strategies that can be applied to support the creative process. These strategies are based on the laws of technical systems evolution, the 40 inventive principles, and the physical effects and phenomena.

Conclusions & practical implications: TRIZ theory has been successfully applied in many fields and now offers an opportunity in molecular gastronomy. This research attempts to implement the concepts, methods and tools of TRIZ theory to improve the creativity of food technologists in the product development process.

Keywords: TRIZ theory, molecular gastronomy, creativity, food technology, innovative cuisine.

VEGETABLE POWDER AS A NATURAL SOURCE OF NITRITE IN THE PRODUCTION OF COLD SMOKED SAUSAGES

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Abstract

Relevance of the topic: Meat industry is heavily criticized for the use of sodium nitrite as conservant. High intake of nitrites poses a risk to human health because it can react with certain amines and form carcinogenic nitrosamines. As consumers increasingly prefer natural, nutritious and healthy products, the industry needs to find ways to reduce or replace nitrites in meat products. The aim of the study was to evaluate the influence of vegetable powder as an alternative to nitrite on the qualitative and sensory properties of cold smoked sausages.

Methodology: Seven cold-smoked sausages were tested: K (control with nitrite salt), LB (with salt and 1% freeze-dried beetroot powder), DB (with salt and 1% dried beetroot powder), LR (with salt and 1% freeze-dried radish powder), DR (with salt and 1% dried radish powder), LP (with salt and 1% freeze-dried leek powder) and DP (with salt and 1% dried leek powder). The changes in colour of sausages were measured with a LC 100 colorimeter, the moisture content was determined by the EXPRES method, acidity was determined by the potentiometric method, water activity was measured with a Rotronic HygroPalm meter and the acceptability of the sausages was assessed by an emotional test.

Results: The vegetable powders affected the decrease in pH and moisture content of sausages. The main negative indicators were pigment intensity and colour change due to betaline effect. The addition of beetroot and radish powder had the best sensory properties, which was confirmed by the consumer acceptance test. Freeze-dried and dried leek powder had the worst properties, both in terms of qualitative indicators (a minimum decrease in moisture content and significant pH fluctuations) and sensory indicators (the worst consumer acceptability).

Conclusions & practical implications: Freeze-dried and dried beetroot and radish powder can be used in the sausage production as an alternative to sodium nitrite.

Keywords: beetroot, cold smoked sausages, freeze-dried, leek, nitrite salt, radish.

LACTOBACILLUS PROBIOTICS EFFECT ON BLOOD LIPIDS PROFILE

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Abstract

Relevance of the topic: The intestinal microbiota plays an important role in maintaining the health of the body, including the protection of the intestinal epithelium, the strengthening of the immune system, and the production of vitamins. Numerous studies have been published in recent years showing the positive health effects of yogurt and the bacterial cultures it contains. It has been scientifically proven that probiotics improve intestinal health, promote the strengthening of the immune system, have an antioxidant effect, reduce allergic symptoms, change the blood lipid profile, and lower blood pressure.

Methodology: 1. Microbiological examination of yoghurt; 2. Study of physicochemical characteristics of yogurt; 3. Experiment. The study involved 21 women aged 45-55 years. Subjects were selected according to certain inclusion and exclusion criteria.

Results: Physicochemical properties of yogurt – moisture, water activity and acidity – comply with regulated norms and are a suitable medium for the survival and activity of living microorganisms. The total and lactic acid bacteria content in natural yoghurt is also adequate under the prescribed legal norms. Six-week intervention of 250 g of natural yogurt had no significant effect on blood lipid profile: total cholesterol, high- and low-density lipoprotein cholesterol, and triglyceride levels ($p<0.05$). No significant changes in arterial and diastolic blood pressure were also recorded ($p<0.05$).

Conclusions & practical implications: Consumption of natural yogurt for six weeks had no significant effect on blood lipids profile and blood pressure. However, when analyzing individual cases, slightly less than half all subjects showed a trendy decrease in blood lipid fraction.

Keywords: intestine, microbiota, yogurt, lipidogram.

PREVENTION OF FOOD WASTE IN THE GASTRONOMIC SECTOR

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Abstract

Relevance of the topic: Food consumption is closely related to our habits, in addition to food waste. Today, food wastage is a significant problem, so it is no surprise that it is constantly tackled every year. The zero-waste movement aims to stop people from using disposable cups, straws, and plastic bags. The movement encourages the use of leftovers and promotes responsible food consumption. Annually, approximately one-third of the world's edible food is lost and wasted, in addition to the resources used for production and the personal income of the population. Unfortunately, there has been no reliable data regarding food waste in Lithuania. Therefore, it is believed that under conditions of the crisis caused by the coronavirus pandemic, in cities, the problem of food waste has become even more relevant than before. As a result, at the beginning of January 2021, an online study was launched to identify the changes in shopping habits and food waste during the pandemic. In November 2020, the research company Norstat carried out an online survey on food waste commissioned by the Maisto Bankas and Swedbank. The methodological part of the research presents comparisons of the results of these two studies and measures for rational food consumption.

Methodology: To achieve the goal of the research, an online survey was conducted. At the beginning of January 2021, a questionnaire was developed to identify changes in shopping habits and food waste during the crisis caused by the Covid-19 pandemic. One hundred three respondents took part in the survey.

Results: The results of the study can be used to educate society about food waste and measures to be taken to mitigate food waste.

Conclusions & practical implications: Food is wasted throughout the food production, marketing, and consumption chain, which is an economical and morally negative phenomenon. It is imperative to develop skills that help reduce food waste in daily life. Measures to prevent food waste would be as follows: not to buy too much, produce as much food as will be eaten, constantly review available foodstuffs at home, first consume perishable products, freeze perishable products, e.g., butter, bread, meat, and fish products, meals, vegetables if possible, and take out food from the freezer just before use. If food discard is inevitable, the best solution is to compost it.

Keywords: COVID-19, food waste, pandemic, perishable foodstuffs.

THE IMPORTANCE OF MATHEMATICS IN ENGINEERING SCIENCES

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Abstract

Relevance of the topic: To determine what basic knowledge of mathematics and applied mathematics is required for learning other subjects in college. To review and analyse the topics of the subject of mathematics in applied engineering science programmes: automation and electrical engineering, car technical operation, automotive electronics, manufacturing engineering, construction, and transport logistics technologies.

Methodology: First- and second-year students were interviewed and the obtained data were analysed. Teachers also were interviewed about what topics were missing from mathematics for the subject they were teaching.

Results: Based on the results of the survey of students and teachers, summaries of relevant topics were prepared.

Conclusions & practical implications: It was determined what mathematical knowledge and competencies are needed for students that study various subjects according to the specified programmes. The prepared summaries will help students to achieve the intended learning outcomes of other subjects.

Keywords: knowledge, mathematics, students, study programmes, topics.

EFFECTIVENESS OF DISTANCE TEACHING OF MATHEMATICS DURING THE PANDEMIC AT KAUNAS UNIVERSITY OF APPLIED SCIENCES

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Abstract

Relevance of the topic: The aim of the research is to analyse the studies of mathematics during the pandemic at Kaunas University of Applied Sciences, in particular emerging difficulties, possibilities to overcome them, efficiency of mathematics teaching and results of remote mathematics studies. The relevance of the topic is based on the fact that remote learning of mathematics in Lithuanian colleges during the pandemic was studied poorly.

Methodology: The research is based on the inductive research method. A qualitative survey method was applied and comparative analysis was performed. Based on the experience of mathematics teachers, students' opinions expressed during surveys and lectures, a comparative analysis of distance mathematics study results was performed: in the spring semester of 2020, in the autumn semester of 2020, and in the spring semester of 2021.

Results: The research discusses the peculiarities of remote teaching of mathematics in the pandemic period, in particular learning outcomes, quality assurance and monitoring of mathematics tasks, adaptation of teaching materials and tasks to distance learning, intensity and workload of distance learning, etc. The research also reviews the advantages of distance learning of mathematics, e.g. development of students' independence, application of new methods, competences of remote work, etc.

Conclusions & practical implications: The research analyses the mathematics studies of the first-year students of the Technology faculty at Kaunas University of Applied Sciences under conditions of the Covid pandemic. The research sample is four groups in the spring semestre of 2020, four groups in the autumn semestre of 2020, and two groups in the spring semestre of 2021. The students who participated in the research major in computer network administration, automation and robotics, food technology, and food safety and quality.

Keywords: distance learning of mathematics, first-year students.

INTERNAL QUALITY ASSESSMENT OF KAUNAS UNIVERSITY OF APPLIED SCIENCES STUDY PROGRAMME "SOFTWARE SYSTEMS" FROM THE STUDENTS' POINT OF VIEW

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Abstract

Relevance of the topic: The popularisation of quality assurance systems in educational institutions and business enterprises encourages the implementation of internal quality assurance systems in many Lithuanian higher education institutions. For this purpose, the university conducts regular reviews of study programmes based on the opinions of students, graduates, faculty, and employers. In order to improve the activities of the Kaunas UAS, it periodically carries out surveys and research in order to identify students' opinion on the internal quality assessment. It requires feedback, which is commonly used in student surveys. The aim of the article is to present the internal quality assessment of the Kaunas UAS study programme "Software System" from the students' point of view. In this case, feedback from first and second-year students on this study program was selected.
The students' survey was performed remotely by filling in the questionnaires developed using Google Forms. During the research, the strengths and areas of improvement of the study program, satisfaction with distance learning and its influence on the results of the subjects were analysed.

Methodology: Statistical data analysis was used to process the survey results. The correlation coefficient was calculated to assess the statistical relationship between two aspects of the questionnaire.

Results: Quality assurance summary was provided. First and second year students of the Software Systems study program were interviewed, and survey results were discussed.
The results of the questionnaires showed that 68.8% of students evaluate highly: the implementation of the study programme, the study process organization, the sequence of the programme subjects (best rated 4.22 out of 5), evaluation methods applied for studies (their assessment exceeded 4 points out of 5). At the lowest points (up to 3) they assessed their participation in the Kaunas UAS activities.
One of the research parts was to find out about students' plans in future. A majority of students, e.g. 59.4% have not yet decided what they will do in the future, 31.3% plan to work according to their qualifications obtained; 3.1% plan to pursue their studies at university; and just 6.3% plan to go abroad.

Conclusions & practical implications: Students' point of view on the Software Systems study programme, its quality assurance and distance learning are provided. The recommendations for the future improvement regarding internal quality and distance learning are provided. Based on the research data, 60% of students were satisfied with the distance learning as this opened wider possibilities to effectively manage their time and master new learning methods.

Keywords: Software systems, internal study quality, students' assessment.

APPLICATION OF INFORMATION TECHNOLOGIES IN THE TEACHING OF MATHEMATICS IN ENGINEERING STUDIES

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Abstract

Relevance of the topic: The level of information technology knowledge of current students has changed. Today, teaching is no longer imaginable without information technology. Information technology is increasingly integrated into the teaching and learning process, becoming an integral part of it. Modern information tools and technologies are encouraged at all levels of the teaching and learning processes in a number of subjects.
Without the application of information technology, it is difficult to imagine the teaching of Applied Mathematics. When studying engineering study programs, a majority of subjects requires proficient knowledge of mathematics. However, these are usually technical calculations. The use of analytical methods in calculations can be considered as a waste of time. Instead of this, students could deepen specific knowledge of the subject. Computer programmes can be used to calculate the results of technical research.
Students should be taught not only to solve math problems analytically, but master Mathcad and Matlab. As a result, students would be better prepared for further studies.

Methodology: Introducing students to the mathematical package Mathcad starts at solving the simplest tasks such as performing operations with real and complex numbers, differentiation, integration (indefinite, definite, indirect integrals; integral with a variable upper bound depending on the parameter). Application of IT in teaching Applied Mathematics covers a number of topics including the Lagrange interpolation polynomial, approximation of experimental data, Fourier line and transform, cubic splines, etc.

Results: As students learn to work with Mathcad, later on, they master Matlab environments in order to solve more complex problems that require mathematical knowledge and the ability to apply IT skills.

Conclusions & practical implications: Students need to be taught a package of Mathcad and Matlab. It is important to gradually develop students' knowledge starting from simple to more complicated tasks.

Keywords: Application, Applied Mathematics, Excel, engineering studies, IT, Mathcad, Matlab.

THE PREMISE OF SELF-EMPOWERMENT: MATHEMATICAL LOGIC OR LOGIC AND EMOTIONS, OR MAYBE TECHNOLOGIES

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Abstract

Relevance of the topic: Mathematics as a science helps to identify, understand, substantiate some truths in our chaotic world. The presentation discusses the relationship between emotions and logic. Their use enables students to think more productively and the application of innovations provided by available technologies results in a productive self-empowerment in a diverse social environment. However, the widespread use of technology promotes selfishness in individuals, posing certain risks such as to live without a common goal, which can be described as the desire to rise to a new level of collective and moral awareness. Mathematical truth is proved through the laws of logic, but emotions can help to understand and feel, and this is again tested on the basis of logic. Therefore, it is important for students to master the elements of mathematical logic, technologies, and at the same time, be able to communicate and cooperate with people with various experiences. The aim of the research is to identify the influence of logic, emotions and technologies on the acquisition of the content of non-university bachelor studies in mathematics within the context of scientific literature.

Methodology: The research is conducted on the basis of selected social constructivism, which enables to respond to the aim of the research including the experiences of learners of mathematics, their historical perspectives, which are defined in the scientific discourse examined by the method of literature analysis.

Results: The analysis of the scientific literature revealed significant factors for the acquisition of non-university Bachelor studies in mathematic as follows: intelligence of context perception, as it is important not only to understand the content, but also to know and be able to apply knowledge in real situations / solving practical tasks; emotional intelligence, enabling to be more creative, resilient, flexible in a changing world; creative intelligence, which creates preconditions and conditions for searching for meaning and purpose; complex circumstances and the increasing pace which requires to stay healthy while maintaining inner peace. Therefore, physical intelligence, which supports a person's physical and mental health and individual's well-being, is extremely important. The development of mathematical logic applying modern technologies can be identified as the premise of the development of multifaceted intelligence.

Conclusions & practical implications: This theoretical research is significant in improving teaching of the subject of mathematics, and in general, expanding and deepening the general understanding of mathematics as a subject, the importance of mathematical logic in the individual's life in the changing world, and in the ability to use them for self-empowerment.

Keywords: mathematical logic, technologies, emotions, intelligence.

APPLICATION OF BLOCKCHAIN TECHNOLOGY TO ATTRACT INVESTMENTS IN PRODUCTION-DELIVERY-REALISATION CHAIN

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Abstract

Relevance of the topic: To attract investments, the transparency and trustworthiness of business processes are required. The blockchain technology provides a new investment mechanism called Initial Coin Offer (ICO) satisfying these requirements. Blockchain technology is proposed for production-delivery-realisation chain modelling, providing business operations monitoring and security.

Methodology: The business model is constructed using a graph model representing business processes in the production-delivery-realisation chain. According to this graph model, all information on the transaction level is available for investors. The money flow is controlled by smart contracts and is executed automatically in the network. In this way, the transparent monitoring of business operations is achieved. The security of business operations is achieved by using cryptographic data security solutions integrated in the system. These solutions provide data accessibility for different kinds of users, data authenticity and person identification.

Results: This model connects all parties: producers, delivers, sellers and investors into transparency and trustworthiness system providing traceability of transactions in production-delivery-realisation chain.

Conclusions & practical implications: Due to transparency and trustworthiness of the production-delivery-realisation chain, this business process model can attract potential investors to participate in the business.

Keywords: authenticity, blockchain, cryptographic data security, ethereum, initial coin offer, smart contracts.

DRONE STADIUM INTERACTIVE SYSTEM

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Abstract

Relevance of the topic: The paper proposes new access to the use of drones and the development of their technical capabilities.

Methodology: Innovative features include an interactive drones flying track offering cordless sensors. The interactive route, via wireless, is associated with a real-time WEB graphical interface. In the work, the Drone stadium interactive system is realised with wireless sensors.

Results: According to the selected criteria, requirements are set for the design of the system. The aim of this work is to create a space without pilots with cordless sensors and to link them with a real-time user interface, thus extending the application of the abovementioned hangars, for example in sports or agriculture, by improving the technical capabilities of hangovers or their components.

Conclusions & practical implications: System algorithms of "Drone stadium interactive systems with wireless local area network sensing networks" have been developed and described. Software of user interface of hang-glider without pilot (drone) has been implemented. During the test, it was found that the technical and software parts meet the requirements set and practically operate in real time.

Keywords: drone racing, ultrasonic sensor, Arduino, WiFi, wireless network.

TECHNOLOGY FOR CAPTURING/UTILISATION OF CO_2,(SO_x, NO_x) FROM THE FLUE GASES

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Abstract

Relevance of the topic: Cement/lime/magnesium productions furnaces emit 150-400°C gases, which, after passing through filters, contain suspended dust and oxides (CO_2;SO_x;NO_x) promoting global pollution. However, CO_2 is "useful", as it accelerates concrete hardening using carbonization nano-process. Cement is blended with 0,05-0,35t/t of $CaCO_3$, which causes a significant increase of natural resources consumption. In any case, the problem requires appropriate solutions.

Methodology: Application of zeolite sorbing agents is important in terms of catching-utilization of dust and CO_2,SO_x,NO_x.Unfortunately, still there is no BAT (Best Available Technology) for catching/utilization of dust/CO_2,SO_x,NO_x. Hypothesis 1: When passing burnt gases emitted to the atmosphere at 150-400°C from cement, clinker, lime, magnesium furnaces, through zeolite drying apparatus, a drying unit acquires new function, i.e. modification into a sorbing agent; zeolite is heated and dehydrated, dust particles experience chemisorptive precipitation on the zeolite, while CO_2,SO_x,NO_x adsorb in its depth. As a result, purified gases are emitted to the atmosphere, while via their utilisation in some zeolite composition, they are "enriched" with CaO,$CaCO_3$,CO_2,SO_x,NO_x, their polymodification occurs, that will generate compounds with fiber-acicular habitus containing (CO2,SOx,NOx). Hypothesis 2: Cement/lime/magnesium enterprise furnaces and dryers are rotary and large in size that hinder the research.

Results: (CO_2,SOx,NOx) after passing through the "hybrid" apparatus, are absorbed in the zeolite tuff, "enriching" and modifying it, and the purified flue gases are emitted into the atmosphere. Zeolite tuff ("container"), modified with (CO_2,SO_x,NO_x) is utilized when milled with cement, contributes to its polymorphization, which is confirmed in hardened cement: portlandite pozzolanization, carbonization, sulfatization, nitration; the formation of stratlingite, ettringite, hydrocarbon aluminate, thaumasite and calcium nitratean accelerator of cement setting and hardening. This technology contributes to the conservation of natural resources: the production of 1t of cement for the utilization of each 0.78t of CO_2 will save 1.77t of $CaCO_3$, and for the utilization of each 5.2 kg of SO_3 it will save 26.5 kg of CaSO4.

Conclusions & practical implications: In the prototype of a "hybrid" apparatus of a production drying drum and a gas sorber, it is possible to conduct a full-fledged technological experiment. The zeolite tuff, present in, is capable to absorb CO_2,SO_x,NO_x from flue gases, completely modifying into their "container", and then utilizing it during grinding and modifying cement.

Keywords: emission, flue gas, modification, absorption, zeolite, cement, technology.

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RENEWABLE ENERGY AS CHANCE FOR ENERGY INDEPENDENCE: A CASE STUDY OF LITHUANIA

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Abstract

Relevance of the topic: Due to increasing population and improving life conditions last decades rapidly grew energy consumption in the world and Europe. Despite the fact that more and more countries pay attention to renewable energy, the main part of energy is generated from fossil fuels. As a result, climate change can be felt more than ever. One of the ways to mitigate climate change is the development of renewable energy sources in the world, including Lithuania. The aim of the research is to reveal the current situation of the development of renewable energy sources, to assess the progress, future development trends and perspectives by assessing economic and technical indicators.

Methodology: Review of renewable energy development state and trends in Lithuania.The research presents comprehensive insights of installed power capacity, efficiency and different metrics. In addition, the research aims to analyse historical statistical data and introduce current renewable energy sources to the National Energy Independence Strategy regarding Lithuania's goals and future scenarios.

Results: Research indicates the weak relation between GDP and RES development. However, the role of RES recently was ranked higher than ever with 41 percent of total electricity produced in Lithuania in 2020. Wind energy was the leader with 63 percent electricity produced from RES and with the highest penetration level of 50 percent during summer period.

Conclusions & practical implications: According to the National Energy Independence Strategy of Lithuania, 70% of electricity by 2030 and 100% of electricity by 2050 has to be produced in Lithuania. However, energy generation from fossil fuels and as a result of that - energy dependence, still remains a big issue. In order to solve these issues regarding energy dependence and to achieve ambitious goals how to introduce climate-neutral technologies, a significant development of renewable energy is planned including onshore and offshore wind energy, solar energy and prosumers, bioenergy systems.

Keywords: renewable energy, energy dependence, climate change.

WASTE SORTING IN LITHUANIA: IS INNOVATION NEEDED?

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Abstract

Relevance of the topic: The problem of waste sorting is relevant in all the world. It is an integral part of sustainable development. The resulting waste is a perceived, huge problem of waste sorting in the global context due to the economic activities of enterprises and the principles of consumption and sorting by the population. In solving this problem, there are lot of scientific discussions about the implementation of the principles of the circular economy in the activities of companies. Great attention is also paid to population responsibility and a harmonized approach to waste sorting. Good waste infrastructure is essential for society to sustainably respond to sorted waste. The aim of this study is to perform an analysis of waste sorting problems in Lithuania. The objectives of the research: 1. To discuss the waste sorting infrastructure operating in Lithuania. 2. To analyse the legal bases of waste sorting in Lithuania; 3. To study the need for innovations in the field of waste sorting in Lithuania.

Methodology: Analysis, synthesis, generalisation of scientific literature. Semi-structured interview. Statistical data analysis

Results: The results of the study showed that in Lithuania a lot of money was invested in the improvement of waste sorting infrastructure. But that is not enough. The data of the interviews showed that there is a problem of a responsible attitude of the society towards sorting. To solve this problem, it is necessary to invest in modern, all-age education programmes on sustainable development, the importance of sorting. On the other hand, fees on household waste disposal are rising sharply. Therefore, a complex innovative model of growing taxes and the development of social responsibility is necessary.

Conclusions & practical implications: The results of the study showed that good infrastructure in the field of waste sorting is not enough. Without a responsible public approach to waste sorting, it is difficult to achieve good results. Waste management fees are rising. However, the increase in these fees does not mean that society will sort more responsibly. On the contrary, this can lead to the opposite effect. It is necessary to educate the society by emphasizing the importance of sorting, providing clear and informative information on why the fee burden of sorting is constantly growing.

Keywords: infrastructure, sustainable development, waste sorting.

TECHNOLOGICAL AND ECONOMIC ASPECTS OF HYPERSPECTRAL IMAGING FROM AN UNMANNED AERIAL VEHICLE (UAV)

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Abstract

Relevance of the topic: Various parameters of the aerial photograph are investigated depending upon the resolution of images received. The resolution is related to the altitude of aircraft flights. Naturally, aerial images obtained from a UAV aircraft are characterized by the highest resolution.

Methodology: During the first stage of assessment (object of 4000 ha) the following technological and economic aspects of aerial photograph focused primarily on hyperspectral imaging were discussed: time period between expositions (s); number of images (items); distance in meters scanned during the exposition in meters and visual pixels; flight duration (h); flight price (EUR); flight number (items). In assessing the influence of the object size an aerial square photograph object of virtual area (10, 100, 1000, 10000 and 100000 ha) was formed, an aerial photograph project was stimulated and the following technological and economic aspects of aerial photograph were assessed: the number of images (items); flight time (h); flight price (EUR); flight number (items). During the third stage, a varying number of virtual objects of various area was generated (1, 2, 5, 10, 20, 30, 50, 100, 200 and 300, randomly distributed in the entire area of Lithuania) and the price of the entire project of aerial photograph and orthophoto plans was determined. The project price consisted of mobilisation, flight operation, aerial image calibration and photogrammetric processing costs.

Results: When discussing various aspects of aerial photography of a virtual object sized 4000 ha, the focus is on the implementation of imaging., i.e., only those platforms where a Rikola camera can be installed are discussed. Provided that the focus is laid on HSI images, it is practically impossible to receive images of equal resolution, the maximum technical flight altitude of a UAV and manned aircraft is 250. Therefore, the use of UAV aircraft for imaging of the territory of ~4000 ha using the Rikola camera is a complicated task from a practical perspective. It is related to a very high number of images, automatically high flight duration and a high flight price. Small objects (~10 ha) are usually covered by 3-4 aerial images using manned aircraft. The number of aerial images received from a UAV is the highest in all cases. Moreover, if an object is sized 10 ha, the relatively cheapest choice would be to operate a UAV flight. The flight price in the case of small-scale projects (10-100 ha) is practically similar in the case of different flight altitudes because the object is usually photographed in some minutes and the part of the price which is relatively highest is related with the period of flight before the object is achieved. It was noticed that HIS imaging flights are relatively cheaper when using an ULO aircraft than in the case of Cessna 172 aircraft in order to photograph small objects (10-1000 ha).

Conclusions & practical implications: Hyperspectral imaging from unmanned aircrafts is efficient from the economic perspective only for small (~10 ha) areas.

Keywords: unmanned aerial vehicle, Rikola camera, hyperspectral imaging, resolution.

APPLICATION OF SUPERCAPACITORS AND MATERIALS USED IN MANUFACTURING

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Abstract

Relevance of the topic: As fossil fuel resources dwindle and prices rise, there is an increasing focus on finding and researching alternative energy sources. This raises a pressing issue for switching fossil fuel sources. One alternative may be supercapacitors. The aim of this work is to evaluate the suitability of plasma spraying technology for the production of supercapacitor carbon electrodes.

Methodology: Using plasma spraying technology, supercapacitor carbon electrodes were formed and their characteristics were investigated. Capacitor electrodes were formed in an atmospheric pressure plasma environment. An electron-scanning scanning microscope (SEM), a classical electrical capacitance measuring stand, was used to study the characteristics of supercapacitors. The data were processed by the software package Origin 6.0.

*Results: I*t was found that with increasing Ar/C2H2 flux ratio from 15 to 55 and 1000 W plasma torch power, the capacitor capacitance decreases from 15 to 4 mF, and the stability voltage decreases from 0.52 to 0.4 V. Meanwhile, at 840 W plasma torch power, as the Ar/C2H2 flux ratio increases from 15 to 55, the capacitor capacity increases from 3 to 5 mF, and the stability voltage remains approximately unchanged.

Conclusions & practical implications: After the analysis of the obtained research results, it can be concluded that the plasma spraying method is suitable for the formation of supercapacitor electrodes. The porous surface of the carbon electrodes is observed by analyzing the SEM surface images, which ensures a good process of double electrical layer formation.

Keywords: supercapacitor, current, capacity, electrodes.

MONITORING SYSTEM OF OPERATION PARAMETER FOR SUPERCAPACITORS

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Abstract

Relevance of the topic: With the development of various electrical and electronic systems manufacturing industries and technologies, it is necessary to solve the problem of their electrical power supply, related to the dimensions of power sources, service life, efficiency, parameter stability, etc. In order to solve the problems of energy storage, efficient use and complexity and efficiency of electrical and electronic systems, more and more attention is paid to the research and possible application of supercapacitors. The aim of this work is to create an electronic monitoring system of supercapacitor operating parameters.

Methodology: The capacitor is charged with a 5 V stabilized current source, a constant impedance resistor (18 k grand), a circuit-breaker connected to a pulse generator and forming a capacitor on-off cycle, a capacitor under test and a digital multimeter (Agilent 34972A) connected to a computer. Appropriate software is used to record the potential difference between capacitor electrodes.

Results: Measurements of specific capacity and charge-discharge cycles were performed using an electronic supercapacitor monitoring system. The results showed that after 10,000 charge-discharge cycles, the specific capacity of supercapacitors decreases by 5%. Due to the existence of a galvanic pair, supercapacitors discharge up to about 0.3 V.

*Conclusions & practical implications: T*he developed electronic system of supercapacitors parameters increased the efficiency of experimental work by measuring charge-discharge cycles by about 90 % compared to manual measurement methods when using a classic supercapacitor charge-discharge stand. Analyzing the charge-discharge cycles, it can be concluded that during each cycle charge is accumulated, the amount of which does not depend on the number of cycles.

Keywords: thermal plasma, temperature, voltage, supercapacitor.

INVESTIGATION OF TiCrN-COATED HIGH SPEED STEEL TOOLS WEAR DURING MEDIUM DENSITY FIBREBOARD MILLING

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Abstract

Relevance of the topic: The paper presents a study on the performance of anti-wear coated and non-coated high-speed steel (HSS) milling knives when milling medium density fibreboard (MDF).

Methodology: There were chosen the standard HSS milling knives of one manufacturer with a similar chemical composition of steel. One group milling tools were standard non-coated HSS milling knives. Second group was milling tools with standard anti-wear TiCrN coating. The tests were done with the MDF samples. The MDF samples were milled at two different cutting and two different feeding speeds. The measured parameter was cutting edge recession and cutting power. The factual values of edge recession were measured using the optical 3D measuring instrument MicroCAD-lite.

Results: The results are presented in diagrams and the form of summaries. After the MDF milling tests had been done under different conditions, it was determined that the knives covered by TiCrN coating are more resistant to wear if compared to the uncovered knives. The cutting path had the biggest influence on the wear of milling knives. When the feeding per cutter increases from 0.5 to 1 mm, the intensity of wear of both knives and cutting power increase.

Conclusions & practical implications: The results of the wear tests of the cutters and measurements of the power consumed in the course of milling MDF in various tests are presented below.
The cutters with wear-resistant TiCrN coating were 9.6% more resistant to wear on average than the cutters without coating. The cutting length had the greatest influence on the wear of the milling cutter blades. The most intensive wear of the cutting blades was registered in the cutting length section up to 918 mm. In the section from 918 to 2726 mm the wear of cutters No. 1 and No. 2 stabilized and gradually became normal.
With an increase in the feed *f* per cutter from 0.5 to 1 mm the wear of both cutters and the cutting power increased. However, the numerical cutting capacity of the cutter with TiCrN coating was 8.44 (at f = 0.5 mm) and 4.52% (at f = 1 mm) lower on average than the results for the cutter without coating.
Since the maximum reduction in the wear of the cutter with TiCrN coating under the conditions of the study was only 29% it is appropriate to continue the research work for determining the optimal cutting tests to extend the resource life of cutters

Keywords: TiCrN coating, HSS, cutting edge wear, milling, MDF.

HOW TO MAKE WOOD SOFT

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Abstract

Relevance of the topic: The aim of the report is to show designers and students that wooden furniture can be not only square in shape, but also curved. For this purpose, three wood bending methods are presented: Method 1: bending wood with steam box. Method 2: bending wood applying lamination. Method 3: bending wood with the kerf-cutting. The topicality of the research is to share experience with young designers and demonstrate specific methods how to to render curved shapes for furtinure made from wood.

Methodology: A common source of information for designers-technologists is consultations with manufacturers and search for specific illustrations on the Internet. The technology of wood softening has been in use for decades and still is important when producing furniture of curved shapes.

Results: After researching the market, the main methods of bending wood were defined.

*Conclusions & practical implications: T*he analysis of wood bending technology showed that it is possible to obtain curved shapes in wood products using steam chamber technique or with the Kerf-cutting Method, or to easily bend wood and render curved shapes in product design. There are several methods of wood bending: layer, steam, water, chemical impregnation, and kerf-cut one. The analysis of wood bending technology showed that it is possible to obtain curved shapes in wood products using steam chamber technique or to easily bend wood.

Keywords: bending, cutting, kerf, lamination, soft, steam, wood.

EXPANSION CAPABILITIES OF INDUSTRIAL PROGRAMMABLE LOGIC CONTROLLERS USING SPECIALIZED EMBEDDED ELECTRONIC MODULES

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Abstract

Relevance of the topic: Many automated applications installed in various industries use industrial programmable logic controllers (PLC). Often, they perform specific tasks assigned to them to control a specific object via digital, analog signals, or standardized communication protocols. However, some applications become too expensive for the end user. In such cases, the control system can be made cheaper and perform the intended functionality by using specific embedded electronic modules (SEEM).

Methodology: Two cases from the agriculture industry were analyzed. First application includes motion PLC which had to control DC motor drivers via CAN protocol, LEDs of inspection camera and camera itself. During operation due to uneven lighting the control of LEDs had to be changed from digital to PWM. However, PLC had no PWM functionality. Second application used PLC to control the watering system. Later, the application task was changed by implementing water content reflectometers to measure volumetric water content and temperature in soil. The implemented PLC was not capable of communicating with reflectometers via specific SDI-12 interface. In both cases PLCs were not able to fulfill updated tasks. Changing existing controllers to new high-level ones or using specific gateways could lead to high costs in new hardware and implementation work for end users. Having analyzed the microcontrollers market, it was decided to use Microchip PIC18 family microcontrollers due to low price and flexible programmability.

Results: In both cases specialized embedded electronic modules were implemented for expanding PLCs control features. First application was supplemented by a PIC microcontroller and a TCP module. After implementing software, motion PLC could transmit messages based on standard TCP/IP protocol to SEEM. Microcontroller acted like a TCP server and generated PWM signals to LEDs. End user could remotely change light intensity from 0 to 100% via web GUI. Second application includes PIC with RS232 module and MOXA RS232/ETH gateway. In this case PLC transmitted data to TCP server, meanwhile it forwarded converted data to microcontroller via RS232. PIC18 acted like a repeater and a multiplexer with specific command recognition. It transmitted commands to 4 reflectometers and retransmitted received measured data to PLC.

Conclusions & practical implications: The research shows incompatibility issues between hardware from different fields of automation. Implementation of additional control features in applications with standard PLCs via standard modules or new hardware needs huge financial investment. However, the usage of SEEM in mentioned applications fulfills necessary functions and costs approximately 200€ per module.

Keywords: embedded electronics, microcontroller, programmable logic controller, TCP/IP.

FEASIBILITY STUDY OF COMPUTER PROGRAMS USED IN THE FURNITURE AND WOOD INDUSTRY

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Abstract

Relevance of the topic: The research is relevant for young people preparing for studies at higher educational institutions. As the level of automation continues to rise, the needs for specific software are increasing. Depending on the production processes, various software is used regarding specific needs. The report reviews CAD, CAM, CAE and BIM, their areas of use and perspectives. As the number of software increases, more and more software packages emerge that can offer more features, from managing individual operations to complete workshop planning from order acceptance to product production, warehousing, and sales.

Methodology: The study consisted of several parts. First, online sources were used to review Computer-Aided Design (CAD) software used for drawing, and then to analyze the software relationship when an action performed by one program is extended to another (furniture drawing and price calculation), highlighting the most commonly used software. The main software packages that have many integrated functions are reviewed later: Computer-Aided Manufacturing (CAM), Computer-Aided Engineering (CAE), Building Information Modeling (BIM).

Results: The analysis has shown that large software packages for the furniture and wood industries cannot fully meet the needs of the entire production industry. In order to perform all the necessary functions, the software interacts closely with other applications and exchanges data. However, most CAD, CAM, CAE, BIM software packages can exchange data with each other, and usually contain all or some of them.

Conclusions & practical implications: As the level of computerization rises, the demand for skilled personnel is increasing accordingly. Therefore, it is important for educational institutions to provide students with basic knowledge. In order not to get lost in the abundance of software, it is necessary to constantly monitor the needs of manufacturers. Software manufacturers are constantly providing updates, changes, or enhancements that can greatly help in optimizing technological processes. Choosing the right software in production can greatly speed up production processes and reduce the final cost of a product. Currently, the focus is on teamwork, where employees perform different functions and the overall result of their work is combined in a single software. Software is increasingly focused on cloud technologies and working online.

Keywords: CAD, CAM, furniture, industry, production, software, wood.

DESIGN OF INNOVATIVE FURNITURE BASED ON THE SCIENCE OF BIOMIMICRY

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Abstract

Relevance of the topic: The science of biomimicry examines patterns in nature, then seeks to solve human problems by imitating or drawing inspiration from these designs. This is done by comparing one of the new disciplines. From the past to the present day, many disciplines have developed designs and solutions inspired by nature. One of the areas where the application of biomimicry plays a major and eco-innovative role is furniture design. With the help of biomimicry application methods (form, process, system) it is possible to easily and modernly design various furniture that would meet the principles of eco-design and the needs of modern man and blend harmoniously into the human living space. Furniture has always been and will be a symbolic aspect of humanity's way of life and cultural richness. Shape, natural structure or materials used in furniture design for both, aesthetic and practical purposes. Designing innovative furniture based on the science of biomimicry is important to extend the life of products in order to reduce resource consumption and environmental damage, as well as the amount of recycled furniture. The aim of the research is to analyze the application of biomimicry in furniture design in order to disseminate the ideas of sustainability, eco-design, ecological and renewable materials.

Methodology: BioTRIZ, design sample analysis, literature analysis were applied in the research. Furniture designs were reviewed based on the concept of biomimicry, inspired by both shapes and structures in nature.

Results: The study found that the application of biomimicry science in furniture design is an eco-innovative way. In order to create long-lasting products (furniture), it is important to understand the social and material network of influence that makes products obsolete and they need to be replaced. In this case, an eco-choice strategy must be chosen that focuses on enabling consumers to use products sustainably. Knowledge of how different life changes affect the longevity of products can be used to develop more adaptable products. The product can be made more adaptable by making it easy to change its appearance, refresh its surface and renew it both, visually and socially. It is also important to take into account material resistance, modular constructions, recycling of finishing materials and product parts. This can be achieved through the application of biomimicry science.

Conclusions & practical implications: Furniture designed by biomimicry is much more sustainable compared to other methods and more adaptable to living spaces. Humans have evolutionarily strong connections with nature to date, and such products, according to biomimicry principles, pollute nature less with furniture waste, as the furniture concept is based on sustainability and renewable energy use of materials.

Keywords: biomimicry, bioTRIZ method, eco-innovation, furniture design, mind-mapping, renewable resources.

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