

14:00 – 14:20 **Melnychuk et al.**

(Local Time Ukraine 14:00 - 14:20)

**The impact of a country's level of economic development on environmental safety**

**Ivanna Melnychuk, Oksana Savko, Serhii Pobihun,  
Nataliia Havadzyn**

*Ivano-Frankivsk National Technical University of Oil and Gas, Ivano-Frankivsk, Ukraine  
King Danylo University (King Danylo University), Ivano-Frankivsk, Ukraine*

There has been established the relationship between the level of a country's economic development and its environmental safety based on identifying patterns of factors influence on the volume of harmful emissions into the air. The dynamics of CO<sub>2</sub> emissions in terms of purchasing power parity in European countries for 1990-2018 is presented. It is noted that there is a gradual and uniform decrease in this indicator in developed countries. With the help of the phenomenological method, there has been carried out the selection, justification and grouping of environmental, economic, social, scientific and intellectual factors influencing the emissions of CO<sub>2</sub>, SO<sub>2</sub>, NO<sub>x</sub> in France and Ukraine. Based on the correlation analysis, there has been determined the nature and degree of influence of the selected factors on the resulting indicators (volumes of harmful emissions). It has been substantiated that the factors with the correlation coefficient  $\geq 0.8$  are taken for the analysis; this gave grounds to assert a close relationship between the factors under study and emissions of harmful substances. It has been established that the number of such factors in France is significantly higher than in Ukraine, this is due to the political and economic situation in the country, the level of implementation of energy-efficient technologies and environmental modernization of enterprises.

---

14:20 – 14:40 **Shatokha et al.**

(Local Time: Ukraine 14:20 - 14:40)

**Climate change mitigation scenarios for the Ukrainian steel sector based on best available technologies deployment**

**Volodymyr Shatokha, Elena Matukhno**

*National Metallurgical Academy of Ukraine, Dnipro, Ukraine*

The plausible scenarios for steel production and consumption and prospects for reducing greenhouse gas emissions by implementing the best available technologies (BAT) in the steel industry of Ukraine towards 2030 are studied. It is shown that the introduction of BAT can reduce specific CO<sub>2</sub> emissions by 25%. Taking into account the possible dynamics of BAT implementation, only in the absence of growth in steel production a reduction in the average annual CO<sub>2</sub> emissions can be ensured. With a moderate growth of steel production, the introduction of BAT enables stabilization of total emissions at about the current level. Under conditions of accelerated growth of steel production, total CO<sub>2</sub> emissions increase even with the introduction of BAT. The results of study show that in order to meet Ukraine's international commitments under the Paris Climate Agreement, the introduction of innovative ironmaking and steelmaking technologies with greater, compared to BAT, CO<sub>2</sub> reduction potential should begin after 2027.

---

14:40 – 15:00 **Khadijah et al.**

(Local Time Indonesia 18:40 - 19:00)

**Ecological restructuring in Bandung Smart City Agenda**

**Ute Lies Siti Khadijah, Edwin Rizal, Rully Khairul Anwar**

*Universitas Padjadjaran, Jatinangor, Indonesia*

Like other cities in Indonesia, Bandung has a smart city agenda called Bandung Technopolis. It is a new thematic urban development innovation strategy to make Bandung even more advanced as a sophisticated city that can serve its population and the leading tourism city in Indonesia. However, this sophisticated urban planning also raises human ecological problems. It is because it requires sufficient land for its implementation. Through descriptive and qualitative methods, this study found that there are attractions between economic benefits, social change, and ecological restructuring involving residents and the city government of Bandung.

---

**15:00 – 15:20 Rizal et al.**

**(Local Time Indonesia 19:00 - 19:20)**

**Agricultural based tourism model in a former erupted mountain in Tasikmalaya, Indonesia**

**Edwin Rizal, M. Taufiq Rahman, Rully Khairul Anwar,  
Ute Lies Siti Khadijah**

*Universitas Padjadjaran, Jatinangor, Indonesia  
University of Bandung, Bandung, Indonesia*

This study discusses how the development of tourism in rural Tasikmalaya, especially Sukaratu Village Sukaratu District, has resulted in switching the function of agricultural land to non-agriculture, namely the rural tourism sector. Besides, this article also discusses the continuing fate of farmers affected by land-use change due to the development of tourism. By using qualitative methods, this study found that with the development of tourism in the Village where this case study was located, there was already a productive agricultural land community that changed ownership by buying and selling. Transfer of ownership is based on being tempted by the price offered by the buyer, which is higher than the prevailing market price. However, some farmers still maintain their agricultural land for various reasons despite the high price offered by these investors. The influence that is seen from the rapid development of tourism in addition to the rampant potential for land-use change is the occurrence of socio-cultural changes that occur in traditional societies, namely changes from closed societies to more open societies, from homogeneous values towards pluralism of values and shifts in social norms is one of the perceived impacts. Specifically, the village community has not been able to balance natural resources with the wealth of its human resources, to be able to deal wisely with the problem of land management.

---

**15:20 – 15:40 Anwar et al.**

**(Local Time: Indonesia 19:20 - 19:40)**

**Community participation in environmental management at Jatiluhur reservoir  
tourism site, Indonesia**

**Rully Khairul Anwar, Mohamad Sapari Dwi Hadian, Hendarmawan,  
Ute Lies Siti Khadijah**

*University of Padjadjaran, Jatinangor, Indonesia*

This study assesses the level of community environmental awareness and community participation in environmental programs through the Purwakarta Regency West Java Clean Lake Jatiluhur Operations Program. The components of the program include social and environmental aspects. Published studies argue that people are aware of various environmental issues but are less involved. The study found that the lack of participation was due to lack of time, interest, and awareness. Recommendations should encourage greater community interest and involvement, including strengthening coordination between the local authority and the community with other stakeholders in line with the objectives of the program.

---

**15:40 – 16:00 Kukreti et al.**

**(Local Time India 18:10 - 18:30)**

**Where do we stand: factors affecting sustainable development**

**Ankur Kukreti, Arun Kant Painolli, Naveen Rana**

*Quantum University, Roorkee, Uttarakhand, India*

In this paper authors have tried to find out what is sustainable development and has deduced most important factors essential to achieve sustainable development. By the help of extensive literature review author have developed a self-designed questionnaire identifying 15 important factors for achieving sustainable development and found out most important factors. In order to do that author have collected responses of 200 respondents on a random basis and used factor analysis to obtain the desired result. Out of the possible 15 factors author has find out 3 most important factors to achieve sustainable development they are Economic Sustainability, Demographic Sustainability and Legal Sustainability. By changing sample size or by changing the area of research or the respondents of the research results might change. This study would help the present generation to find out the factors and few parameters that they need to save and preserve for the future generation without compromising their own needs. On 25 September, 2015 United Nation gave 17 global goals that were designed to achieve sustainable future for all. In this study author has tried to find out the most important factors that would help in achieving those 17 goals.

---

**16:00 – 16:20 Krysovaty et al.**

**(Local Time Ukraine 16:00 - 16:20)**

**Circular economy as an anti-crisis method for global economy recovery under COVID-19: employment and tax shift effect**

**Andriy Krysovaty, Roman Zvarych, Iryna Zvarych, Nataliia Reznikova, Homotiuk Viktoriia**

*West Ukrainian National University, Ternopil, Ukraine,  
Taras Shevchenko National University, Kyiv, Ukraine*

The proliferation of plastic waste and the pollution of the world's waterways before the Covid-19 pandemic have caused serious concern in an increasing part of the world's population. At the same time, politicians, companies and international organizations, such as the United Nations, urged action. Some national and local authorities have introduced taxes and bans on disposable plastic (although not all have met their obligations). Large companies have invested in more environmentally friendly packaging.

---

**16:20 – 16:40 Skobelev**

**(Local Time: Russia 16:20 - 16:40)**

**Building the infrastructure for transforming russian industry towards better resource efficiency and environmental performance**

**Dmitry Skobelev**

*Research Institute “Environmental Industrial Policy Centre”, Moscow, Russia*

This study is devoted to the principles and results of the development of the infrastructure for transforming Russian industry towards better resource efficiency and environmental performance. To support transition of the national economy (and first of all – industry) to more sustainable mode of operation, the concept of Best Available Techniques (BAT) is used. Russian environmental industrial policy includes two inter-related directions, namely: (1) implementation of Best Available Techniques and BAT-driven enhancement of resource efficiency and (2) return of secondary resources into the economic turnover. The infrastructure being built to implement the Environmental Industrial Policy is presented as a five-layer structure including (1) regulated community and authorities enforcing environmental and resource efficiency related legislation; (2) research bodies and training institutions developing new technological processes and technical solutions, working out economic rationale for transferring the national economy towards more sustainable development; (3) Russian BAT Bureau coordinating development of Reference Documents on Best Available Techniques (BREFs) and national standards and supporting collaboration of interested authorities; (4) the system of national BAT standards forming the methodological basis for working out BREFs, implementing BATs and achieving BAT-Associated Emission and Performance Levels; and (5) national laws, Government decrees and ordinances and BREFs setting requirements to the resource efficiency and environmental performance of Russian industries. The infrastructure is being continually developed using national and international experience and providing opportunities for gradually moving Russian economy towards better circularity and sustainability.

---

**16:40 – 17:00 Tikhonova et al.**

**(Local Time Russia 16:40 - 17:00)**

**Best available techniques and best environmental management practices: collaboration between industries and regions**

**Irina Tikhonova, Tatiana Guseva, Eugene Averochkin, Kirill Shchelchkov**

*Dmitry Mendeleev University of Chemical Technology of Russia, , Miusskaya square, , Moscow, Russia  
Research Institute “Environmental Industrial Policy Center”, , Stremyanniy pereulok, , Moscow, Russia*

This study analyzes two concepts used to reduce environmental impacts and to improve environmental performance of industrial activities. The concept of Best Available Techniques (BAT) is used in many countries as the major regulatory one, while the concept of Best Environmental Management Practices falls under the category of voluntary approaches, promoted by the European Union (EU). BEMP is understood as the most effective way to implement the Environmental Management System (EMS) to achieve the best environmental performance. Whereas Reference Documents on BAT have been drawn up, reviewed and used since the 1990s, Sectoral Reference Documents (SRD) on BEMP developed since 2009, are much less known, especially outside the EU. Priority sectors for SRD are set by the European Commission (EC) and include both “heavy” industrial sectors regulated by BAT-related legislation and such areas as Public Administration, Tourism, and Telecommunications. Several examples of BEMP implemented by Russian companies are presented. Some of them develop BEMP as EMS voluntary procedures relevant from the point of view of Sustainable Development Goals (SDGs).

---

17:00 – 17:20 **Dryhola et al.**

(Local Time Ukraine 17:00 - 17:20)

## Revitalization strategies of old industrial regions in EU

**Kristina Dryhola, Alyona Khlivitskaya**

*Prydniprovska State Academy of Civil Engineering and Architecture, Dnipro, Ukraine*

The purpose of this study is the analysis of successful revitalization strategies of old industrial regions in EU countries in order to identify the features of their development and build a matrix of investment priorities. Revitalization strategies are a way to achieve long-term sustainable development of territories in the economic, ecological and social subsystems. In the course of the study, successful revitalization strategies of old industrial regions of the following countries have been analyzed: the Netherlands, Italy, Great Britain, Germany, Sweden, Poland. The strengths and weaknesses of the development of old industrial regions were identified, on the basis of which an extended SWOT-analysis was carried out for the first time, the result of which was the construction of a matrix of investment priorities. The results of the study can be used by countries to build programs for the revitalization of depressed areas in order to achieve a high level of sustainable development and overcome crisis phenomena in the economic, environmental and social spheres.

---

17:20 – 17:40 **Arango**

(Local Time: Colombia 09:20 - 09:40)

## Environmental awareness in university students: study case for virtual courses

**David Alberto García Arango**

*Corporación Universitaria Americana, Barranquilla, Atlántico, Colombia*

University social responsibility in achieving Environmental Goals has been considered as one of the main challenges in the current era. The development of new technologies has raised the need in Higher Education Institutions to articulate the way in order to survive. Among this articulation is the importance of generating environmental awareness within the framework of the professional competences of students. This article sets out the practical results and implications of identifying factors associated with the concept of environmental awareness in the data obtained from the application of a previously validated questionnaire to a sample of 121 students of Industrial Engineering and Systems Engineering programs in virtual courses. The results that have been obtained from a factorial analysis of main axes with direct oblimin rotation in delta 0, present the existence of seven factors containing categories of knowledge, beliefs, conative aspects and action by the environment. Descriptions of the factors obtained under the Environmental Goals are generated. In conclusion, practical implications are presented for the identification of these factors in terms of curricular management for sustainability education.

---

~~17:40 – 18:00 **Estrada et al.**~~

~~(Local Time Colombia 09:40 – 10:00)~~

**Moved to 20 October**

## ~~Consumption decision of economic agents: cost vs. environmental awareness~~

~~**Uvenny Quirama Estrada, Andrés Felipe Puerta Molina, Jovany Sepúlveda Aguirre, Luis Fernando Garcés Giraldo, David Alberto García Arango**~~

~~*Corporación Universitaria Americana, Medellín, Antioquia, Colombia*  
*Universidad EAFIT, Medellín, Antioquia, Colombia*~~

~~Research aimed at the search for the sustainability of the planet through the development of environmentally friendly goods (green goods), has generally shown, in its marketing process, a cost higher than the sale price of a substitute good. conventional that does not equally satisfy the reduction of climate change. From the recognition of the average income per individual of a developing country and attending to the rational consumer microeconomic theory, where it seeks to maximize profit with the acquisition of goods at an optimal price and where satiety does not exist, This document, using a mixed exploratory type methodology, seeks to identify from behavioral economics, how willing is the existing demand in the market to the acquisition of a green good with a value higher than its substitute goods, and what are the characteristics of the individual that reflects within its consumption conditions the environmental benefit; at the end of the investigation, the data evidenced by the primary information acquired from surveys is concluded, which reflects conditions of the consumption decision based on age, income, educational level, among other aspects.~~

---

**18:00 – 18:20**    **Liranzo-Gómez et al.**

**(Local Time Dominicana 11:00 - 11:20)**

**Adaptation and sustainable management of massive influx of sargassum in the Caribbean**

**Rolando Esteban Liranzo-Gómez, Daniel García-Cortés, Ulises Jáuregui-Haza,**

*Instituto Tecnológico de Santo Domingo, Santo Domingo, República Dominicana.*

*LPL CONSULTING GROUP.SRL, República Dominicana.*

*Instituto Superior de Tecnologías y Ciencias Aplicadas, University of Havana, La Habana, Cuba*

The massive influx of sargassum is a problem that affects several countries in Africa and the Caribbean. Even though a decade has passed since the first event, an integrated management and adaptation strategy for this phenomenon have not yet implemented in most of these countries, with environmental, economic, and social effects, aggravated by the continuous growth of the quantities that land year after year. This work analyzes the publications since 2011 related to the sargassum invasion in the Caribbean area, the environmental management, and the solutions that allow us to face the current situation in a coordinated and efficient way. The prediction of sargassum streaks continues to be an unsolved problem for most Caribbean countries, which requires an urgent solution. On the other hand, the evaluation of the ecological impact of sargassum invasions on ecosystems has poorly documented, which requires further scientific research in this field. Regarding the management of this phenomenon in sectors such as tourism and fishing, it is necessary to continue systematizing the experience of all these years to establish coordinated strategies and management and adaptation plans that allow minimizing the negative impacts that the massive influx of sargassum causes on both sectors. Lastly, it is necessary to continue making coordination efforts among all the actors that are investigating this topic, to validate the best experiences implemented in all stages of the sargassum management process, including such core issues as the conservation of sargassum and its use as raw material for different applications.

---

**18:20 – 18:40**    **Gubina**

**(Local Time: Ukraine 18:20 - 18:40)**

**Investigative and other body competent in matters related to marine accidents and incidents in the EU countries**

**Ganna Gubina**

*Odessa State Agrarian University, Odessa, Ukraine*

Each country must have a special body that is empowered to deal with the mitigation of the consequences of maritime accidents and incidents. The purpose of the study is to analyze the legislation of some EU countries, which have established an impartial permanent investigative body competent in matters of maritime accidents and incidents (hereinafter - IPIBCMMAI). And on the basis of it, identify positive and negative aspects in the subordination, structure, competence of such a body, offer recommendations for rational and effective changes in this direction. It is carried out using the following methods: 1) a random selection of EU countries, where there is IPIBCMMAI, and the study of their national legislation; 2) assessment of some components of the legal status of this body in the above-mentioned EU countries; 3) the author's recommendations for improving national legislation in the analyzed EU countries on the issue under consideration regarding the effective functioning of the IPIBCMMAI to maintain environmental safety in the world using the modeling method.

---

**18:40 – 19:00**    **Vargas et al.**

**(Local Time Dominicana 11:40 - 12:00)**

**Design and assessment of a domestic wastewater treatment system based on a constructed wetland with subsurface flow in Jarabacoa, Dominican Republic**

**Enmanuel Vargas, Yvelisse Pérez, Willian Hernández, Humberto Checo, Daniel García-Cortés, Ulises Jáuregui-Haza,\*\***

*Plan Yaque, Jarabacoa, República Dominicana*

*Instituto Tecnológico de Santo Domingo, Santo Domingo, República Dominicana*

*Ministerio de Medio Ambiente y Recursos Naturales, Santo Domingo, República Dominicana*

*Instituto Superior de Tecnologías y Ciencias Aplicadas, University of Havana, La Habana, Cuba*

A diagnosis, carried out as part of the conception of the National Sanitation Strategy of the Dominican Republic, states that 75% of the population does not have sewerage services, and just around 10% of the wastewater generated receive some treatment. Furthermore, the discharge of sewage from more than a million septic tanks in the country constitutes the largest source of diffuse pollution. Regarding the above mentioned, "Plan Yaque" (Plan for the Sustainable Development of the Yaque del Norte River Basin) has implemented a relatively cost-effective solution in "El Dorado," a small peri-urban settlement in Jarabacoa municipality. Nonpoint source pollution was converted into point source through a system that collects all the sewage from each septic tank and, then, brings those wastewaters into a nature-based treatment system (constructed wetland with the subsurface flow). This work shows the results

obtained in the assessment of the design and exploitation of a wastewater treatment system targeting to reduce the pollution's load that is affecting the Yaque del Norte River Basin. The treatment system is based on a sewer system that brings the sewage from the houses into two septic tanks, from where they are brought to a constructed wetland. The 70 m<sup>2</sup> wetland was designed to treat the sewage generated by 75 inhabitants. Because of the treatment, the decrease of the pollutant's load into the inflowing sewage achieved an average removal value of 93% for COD, 95% for BOD, 98% for fecal coliforms and 44% for phosphorus as orthophosphate. The system could potentially spread out in other peri-urban settlements in developing countries.

---

**19:00 – 19:20**

**Oliveira et al.**

**(Local Time Brazil 12:00 - 12:20)**

**Actions to inhibit environmental impacts on clandestine landfills in the Amazon**

**Maria do Perpétuo Socorro Lamego Oliveira, Evailton Arantes de Oliveira, Ana Margarida Fonseca**

*University Fernando Pessoa, Porto, Portugal*

This research studies the negative environmental impacts of clandestine landfills in the Amazon, caused by the illegal disposal of construction waste. In the city of Manaus, located in the center of the Amazon, Brazil, there is a public landfill comprising a solid waste collection complex with an area of 660,000.00 m<sup>2</sup>. In 2018, this landfill received approximately 932,927.00 t of solid urban waste, an average of 2,537.20 t/day. Unfortunately, less than 1% of this waste was destined for valorization (0.92% were for composting, and 0.05% were recycled). This legalized public landfill does not accept the disposal of construction and demolition waste, claiming the decrease in the lifetime of the landfill. However, this regional public policy prohibiting the disposal of construction and demolition waste in public landfills favors the use of clandestine landfills with harmful effects on the environment of the Amazon. This research presents proposals for actions to validate a mobile phone application with the authorities responsible for the Manaus landfill for recycling construction waste, with the aim of stimulating the circular economy and inhibiting the negative environmental impacts of illegal clandestine landfills.

---

14:00 – 14:20 **Pramaningsih et al.** (Local Time: Indonesia 19:00 - 19:20)

**Water quality analysis of Benanga reservoir, in Samarinda, East Kalimantan, Indonesia**

**Vita Pramaningsih, Deny Kurniawan, Syamsir, Mardiana**

*Universitas Muhammadiyah Kalimantan Timur, Samarinda, Kalimantan Timur, Indonesia*

Benanga reservoir has functions as a flood controller in Samarinda. It also for used water treatment intake. Surface condition of the reservoir is currently covered by aquatic plants and sedimentation occurs. Many people live on the edge of the reservoir and dispose of their household waste in the reservoir and use reservoir to fish cages. Purpose this study was to measure water quality of the reservoir and compared with the standard of district regulation, East Kalimantan Regional Regulation No. 02 / 2011 concerning management of water quality and water pollution control. Sampling point were 5 locations by purposive sampling. The location is crowded with aquatic plants (1), near cages (2), locations where there were no aquatic plants and cages (3), reservoir outlets (4) and water treatment intake (5). Sampling is done by composite. Samples were analyzed in the laboratory and compared to the standard. Result of the study obtained an average of pH 5.3; temperature of 28oC; DO 3.23 mg/L; BOD 18.43 mg/L; COD 26.27 mg/L; TSS 13.28 mg/L; Nitrite 0.0042 mg/L; Nitrate 0.2 mg/L; Ammonia 0.3214 mg/L; Phosphate 0.0105 mg/L and Fecal Coliform 392 MPN/100mL. Parameters of pH, DO, BOD, COD, Fecal Coliform exceeding the standard and temperature, TSS, Nitrite, Nitrate, Ammonia, Phosphate meet the standard.

---

14:40 – 15:00 **Zelinskaya et al.** (Local Time Russia 19:40 - 20:00)

**Theoretical aspects of disposal of liquid mineral waste**

**Elena Zelinskaya, Natalia Tolmachova, Sergey Pronin, Alexander Garashchenko, Anastasia Kurina**

*Irkutsk National Research Technical University, Irkutsk, Russia*

The study is devoted to the substantiation of the possibility of isolating valuable components from highly mineralized natural-man-made waters, which are simultaneously exposed during the development of oil, gas fields and solid minerals. In modern conditions, these waters become waste. Moreover, they have all the characteristics of hydromineral raw materials. To effectively involve them in secondary use, it is necessary to identify potentially possible conditions for the selective separation of components from a multicomponent system, including using the climatic features of the territories that allow the use of cryotechnology.

---

15:00 – 15:20 **Burdonov et al.** (Local Time Russia 20:00 - 20:20)

**To the question of purification of aluminum-containing material of aluminum electrolyzers**

**Alexander Burdonov, Vyacheslav Barakhtenko, Elena Zelinskaya, Lyudmila Gavrilenko**

*Irkutsk National Research Technical University, Irkutsk, Russia  
Engineering and technical center «RUSAL», Krasnoyarsk, Russia*

At the enterprises for the production of aluminum, equipped with electrolyzers with self-baking anodes, during technological operations for the maintenance of baths and adjusting the chemical composition of the electrolyte, alumina and fluoride salts spill out through the ventilation grilles to the "zero" marks of the potrooms. As a result, an alumina-containing estimate of a complex variable composition is formed, containing a significant amount of valuable components - Na<sub>3</sub>AlF<sub>6</sub>, Al<sub>2</sub>O<sub>3</sub>, AlF<sub>3</sub>. In the process of sweepings collecting the estimate particles of valuable alumina turn out to be mixed with various materials (pieces of asphalt and concrete, sand), which leads to contamination of raw materials with iron and silicon-containing compounds (SiO<sub>2</sub>, Fe<sub>2</sub>O<sub>3</sub>) and makes it impossible to return it to the electrolysis process. This article is devoted to the issue of creating a technological scheme for processing alumina-containing estimates to reduce the content of SiO<sub>2</sub>, Fe<sub>2</sub>O<sub>3</sub> impurities. According to the results of studying the phase composition of the samples, it was found that the estimate mainly consists of cryolite, chiolite, corundum, quartz, feldspar, carbonaceous matter and the technogenic phase of the composition (NaF)·1,5CaF<sub>2</sub>·AlF<sub>3</sub>. Highest concentrations of Si (1,91 %) and Fe (0,62 %) were found in size class of -0,63+0,315 mm. On the basis of microscopic studies, the contrasting properties of the raw materials were established. The developed hardware and technological scheme of processing allows for the processing of alumina-containing estimate, which will provide a product yield in the amount of 90% with Fe<sub>2</sub>O<sub>3</sub> content - up to 1% and SiO<sub>2</sub> - 1.5%, which will improve the technical and economic performance of production.

---

14:20 – 14:40 **Kravchenko et al.**

(Local Time Ukraine 14:20 - 14:40)

### **Refining the hydrocavitation technology for recycling hydraulic fracturing flowback water by using numerical simulation and physical modelling methods**

**Oleg Kravchenko, Vitalii Homan, Iryna Suvorova, Ihor Baranov**

*A.N. Podgorny Institute for Mechanical Engineering Problems NAS of Ukraine, Kharkov, Ukraine*

A methodology was developed for determining the impact of hydrocavitation activation on the consumer properties and energy ecological characteristics of combustion of new kinds of composite fuels. This methodology, jointly with numerical simulation and physical modelling methods enables refining the design of process equipment for the production, spraying and combustion of composite fuels comprising organo-mineral wastewater of different origin. An energy-technological complex was developed to conduct physical modelling and comprehensive research in the fluid dynamics and heat-and-mass transfer during the hydrocavitation activation of fuel mixtures, and to hold industrial tests of the developed technologies. The application of the developed methodology and of the energy-technological complex improved the hydrocavitation technology of recycling hydraulic fracturing flowback water as a part of composite boiler fuels. In particular, the following was achieved: the stability parameters of the produced fuel mixture were improved; the efficiency parameters of the processes of combustion of the investigated composite fuel were improved; the amount of hazardous substances in atmospheric flue gas emission was reduced.

---

14:40 – 15:00 **Abdyzhaparova et al.**

(Local Time Russia 14:40 - 15:00)

### **Decomposition of organic waste in caves**

**Aigerim Abdyzhaparova, Artemiy Spasenov, Svetlana Mazina**

*RUDN University, Moscow, Russia*

*Lomonosov Moscow State University, Moscow, Russia*

This study considers the problem of organic matter decomposition in alpine-type caves. The aim of this study was to evaluate the decomposition of food waste and fecal sludge in the cave conditions by using the clay sediments of the Snezhnaya cave. The model experiment was conducted, where the cave conditions were simulated. In the experiments, we used the following products: mashed potatoes, buckwheat and rice porridge, and fresh fecal sludge. Three types of standard waste management were modeled: they were placed on the soil, buried in the soil and scattered with carbide sludge. The waste decomposition was evaluated by two methods: by the amount of carbon remaining in the soil and by the amount of carbon dioxide emitted from the system. As a result, it was revealed that the decomposition of waste that was buried in the substrate occurs faster. Buckwheat porridge and mashed potatoes decompose slower. In all variants of the experiment, decomposition of fecal sludge in the soil revealed bacteria of the *Escherichia coli* group and *Clostridium perfringens*. It was revealed that when waste was filled with mined carbide sludge, the decomposition of organic matter slows down and the number of sanitary-indicative microorganisms grows.

---

15:00 – 15:20 **Kovalev et al.**

(Local Time Russia 15:00 - 15:20)

### **Biogas and landfill gas converting to gas motor fuel through clathrate hydrate**

**D.A. Kovalev, A.A. Kovalev, V.S. Grigoryev, Yu.V. Litty, M.I. Egorov**

*Federal Scientific Agroengineering Centre VIM, Moscow, Russia*

*Federal Research Centre "Fundamentals of Biotechnology" of RAS, Moscow, Russia*

*RUDN University, Moscow, Russia*

Every year the amount of municipal solid waste (MSW) generated increases significantly. The main method of disposal of MSW is still their burial at landfills. Landfill gas emissions into the environment cause negative local and global effects. At the same time, landfill gas is an alternative source of heat and power generation. To simulate the processes of anaerobic decomposition of organic matter contained in the landfill body, a lab-scale biogas plant was developed. Municipal sewage sludge (SS), organic fraction of MSW and their mixture were used as substrates for anaerobic digestion. It has been shown that the methane content in the resulting biogas rarely exceeds 60%, which does not allow it to be used as a motor fuel; in addition, the presence of hydrogen sulfide in biogas (0.01-0.06%) negatively affects the resource of internal combustion engines. The analysis of methods and technical solutions for the most efficient and environmentally friendly utilization of the generated gas was carried out. For additional purification prior to use as a motor fuel, a technical design of the one-stage gas hydrate production process from biogas and landfill gas has been proposed. The unique properties of gas hydrate and its advantages over other methods of purification and storage of biogas and landfill gas confirm the promising nature of the proposed technology.

---

**Waste usage as secondary resources**

**Oleksandr Gorbenko, Serhii Lyashenko, Anton Kelemesh, Viacheslav Padaka, Antonina Kalinichenko**

*Poltava State Agrarian Academy, Poltava, Ukraine*

*Institute of Environmental Engineering and Biotechnology, University of Opole, Opole, Poland*

The current state of waste management in Poltava region is summarized in this article. In this article were determined places of accumulation and the influence of population size on the volumes of domestic solid wastes formation. Here also was analyzed dynamics of changes in the production of domestic solid wastes in rural areas and in cities. The morphological composition of domestic solid wastes was determined due to researches during 2017-2019. In the article was conducted comparative analysis of the data of changes in the percentage of components, which are part of domestic solid wastes depending on the time of year. It is determined that about 55% of the waste is the organic part of domestic solid wastes. Using certain technologies organic part of domestic solid wastes can be processed into valuable products. The technology of processing the organic component of domestic solid wastes into compost adapted to conditions of private farm households is offered in this article. Here are justified the design parameters of small-sized household chopper for compost production and are given technical conditions of machine usage in the conditions of private farm households. Here also was calculated economic feasibility of machine usage for three farm households for the purpose of processing the organic component of domestic solid wastes into compost. The costs for equipment, materials and inventory were about 2,835 thousand EUR. Costs for electricity, water, wages, etc. were 4,379 thousand EUR. The cost of production of one kilogram of compost was 0.093 EUR/kg. The payback period of the project is 9 months. The use of new developed equipment for the processing of organic component of domestic solid wastes makes it possible to reduce the ecological environmental impact to a considerable extent. In addition, the use of wastes as secondary resources makes it possible to obtain funds for private farm households.

**Biomass fuel from oil palm empty fruit bunch pellet: potential and challenges**

**Agus Haryanto, Dewi Agustina Iryani, Udin Hasanudin, Mareli Telaumbanua, Sugeng Triyono, Wahyu Hidayat**

*University of Lampung, Bandar Lampung, Indonesia*

This study aims to determine the potential and challenges of oil palm empty fruit bunch (OPEFB) pellet as biomass fuel. The study was conducted by observing the process of commercial OPEFB pellets production and analysing some characteristics of the pellets. Proximate and ultimate analysis were carried out to determine the characteristics of pellets, namely mass specific, bulk density, water content, ash content, lignocellulose composition, and calorific value. In addition, XRF analysis was conducted to determine ash composition. Results showed that pressure applied during pellet production affected water content and density of the pellets. OPEFB pellets made with pressure of 90 MPa showed stronger characteristics than the pellet produced with 55 MPa. The pellets had a hexagonal cross section with diameter and mass density of 8.88 mm and 1.55 g/cm<sup>3</sup> for pellet produced at 90 MPa, and 9.65 mm and 1.39 g/cm<sup>3</sup> for pellet produced at 55 MPa. Calorific value of OPEFB pellet (15.82 MJ/kg) was still lower than the standard, while ash content was higher than the standard. High ash content and high mineral content are the main problems need to be addressed in order to safely use OPEFB pellet as fuel, especially for big industries or for generating electricity.

**Assessing thermodynamic parameters of hydrochar of off-specification compost and olive tree pruning for improving combustion performance**

**Judith González-Arias, Elia Judith Martínez, Marta Elena Sánchez, Jorge Cara-Jiménez**

*Chemical and Environmental Bioprocess Engineering Group, Natural Resources Institute (IRENA), University of León, León, Spain*

Hydrothermal carbonization of different residues allows to homogenize the products since hydrochar shows similar properties. Olive tree pruning and off-specification compost, two abundant wastes in Spain, were selected and treated by hydrothermal carbonization. Hydrochars were blended in different proportions to assess their behavior during combustion. Thermogravimetric analysis was the tool used for obtaining necessary parameters such as maximum peak temperature or apparent activation energy, from which the desired thermodynamic parameters can be calculated. Experimental results of kinetic and thermodynamic parameters of the blends during combustion were compared with those calculated with the results of the individual materials. Therefore, co-hydrothermal carbonization and co-combustion were evaluated and compared in terms of combustion performance. Experimental and calculated thermodynamic parameters were obtained, described and exposed in the text with the final aim of selecting the optimal blend for its use as solid biofuel.

16:20 – 16:40 Sa et al.

(Local Time: Russia 16:20 - 16:40)

### Flow simulation of MCNT blended diesel fuel in the nozzle of a diesel injector

Bowen Sa, Vladimir Markov, Ying Liu, Vyacheslav Kamaltdinov

*Bauman Moscow State Technical University, Moscow, Russia  
South Ural State University, Chelyabinsk, Russia*

Multi-walled carbon nanotubes are regarded as promising diesel fuel additives to improve engine performance and emission characteristics. The density and viscosity of multi-walled carbon nanotube blended diesel fuel were analyzed. Flow simulations in the nozzle of an injector Spray A of Engine Combustion Network were performed by using the CFD program Fluent to investigate the effect of introducing multi-walled carbon nanotube to diesel fuel on the characteristics of the internal nozzle flow. The addition of multi-walled carbon nanotubes increases the averaged turbulent kinetic energy of diesel fuel at the orifice outlet in the stabilized injection stage. The presence of multi-walled carbon nanotubes has an insignificant influence on the rate of injection and velocity distribution in the nozzle.

---

16:40 – 17:00 Kharytonov et al.

(Local Time Ukraine 16:40 - 17:00)

### Thermal analyses of differences for woody species depending on soil conditions

Mykola Kharytonov, Viktoriia Kalyna, Nadiia Martynova,  
Margaryta Sbytna

*Dnipro State Agrarian and Economic University, Dnipro, Ukraine,  
Oles Honchar Dnipro National University, Dnipro, Ukraine  
Institute of Energy Crops and Sugar Beet of NAASU, Kiev Ukraine*

Specific characteristics of soil substrates and different climatic conditions indirectly affect the thermal behavior of wood mass. Differences in the wood thermal characteristics of the different trees grown under different soil conditions most likely depend on changes in the composition of the extracted substances, which are most susceptible to environmental influences. The substrata properties affect the thermal characteristics of the wood. Changes are manifested in the speed of reactions, the content of volatile components and changes in the ash content of wood. In turn, extractive substances contribute to reducing or increasing the proportion of carbon in wood, changing the rate of mass loss, shifting the temperature intervals of thermal degradation.

---

17:00 – 17:20 Granda-Rodriguez et al.

(Local Time Colombia 09:00 - 09:20)

### GIS in Colombian post-conflict land use planning

Hernán Granda-Rodriguez, Jenny Patricia-Vanegas, Daniel Robledo-Buitrago, John Jairo Castañeda, Edier Fernando Ávila-Vélez, Miguel A. De Luque-Villa,

*Universidad de Cundinamarca, Fusagasugá, Colombia  
Pontificia Universidad Javeriana, Bogotá D.C, Colombia*

This research collected and interpreted geographic and temporal data on changes in land use coverage in order to improve sustainable development and land use planning in Sylvania, Colombia. This study was carried out in the municipality of Sylvania, Colombia where a spatio-temporal land cover change analysis was carried out for the years 1994 to 2018. Photointerpretation of satellite images was done with ArcGIS 10.5, following the Corine Land Cover methodology. In the last 20 years in the municipality of Sylvania, land use changed from Forest and semi-nature areas; only 6% was lost. These changes were not significant when compared to other areas in Colombia where deforestation has increased after armed conflict ended. Armed conflict in Sylvania may have, to some extent, prevented an accelerated rate of deforestation. Strategic planning is urgently needed in this municipality with the help of different technological tools, such as GIS, that are important for land use planning because they facilitate the understanding and analysis of information related to the territory.

---

17:20 – 17:40 **Acuña-Mendez et al.**

(Local Time: Colombia 09:20 - 09:40)

**Airport noise impact assessment using noise maps and Pittsburgh sleep quality index: a case study in Bogotá, Colombia**

**Andrés Camilo Acuña-Mendez, Juan Diego Virguez,  
Camila Alejandra Canchon-Triana, Miguel De Luque-Villa,**

*Universidad de Cundinamarca, Fusagasugá, Colombia  
SERUANS ENVIRONMENT SAS, Bogotá D.C., Colombia  
Pontificia Universidad Javeriana, Bogotá D.C, Colombia*

A study was carried out in the Fontibón District in order to assess the impact of the El Dorado Airport on the environmental noise component in this community. The environmental noise levels were characterized at 32 points within the town using the methodology indicated in Resolution 627 of 2006 from the Ministerio de Ambiente y Desarrollo Sostenible - MADS (Ministry of Environment and Sustainable Develop) with a type II sound level meter, observing the environmental noise distribution with noise maps designed with Arc-GIS 10.5 and the Pittsburgh Sleep Quality Index, Colombia version. In order to quantify the impact of the environmental noise from the activities of the El Dorado Airport, the methodology proposed by Conesa-Fernández was applied, which was adapted to the characteristics of the project to define and weigh the evaluation criteria and determine the importance of the effects. The results from the monitoring points were compared with Article 17 of Resolution 627 of 2006 for each sector, showing 16% noncompliance for the daytime hours and 66% noncompliance for the night-time hours. The Pittsburgh Sleep Quality Index showed that more than 90% of the surveyed residents present a disturbance in sleep quality, which led to the evaluation of the importance of the environmental impacts, that is modifications in the sound pressure levels and modifications in the sleep quality, on the environmental noise component, which were deemed severe for the Fontibón District of Bogotá DC.

---

17:40 – 18:00 **Chernysh et al.**

(Local Time Slovakia 17:40 - 18:00)

**Polymer materials: bibliographic data analysis and trend detection**

**Yelizaveta Chernysh, Magdalena Balintova, Igor Roy, Stefan Demcak**

*Sumy State University, Sumy, Ukraine  
Technical University of Kosice, Kosice, Slovakia*

Alternatives to waste management methods include the reorganization, recycling, and creation of environmentally friendly biodegradable polymer materials based on renewable resources, plant, and textile waste. The goal of this study is to analyze bibliographic data and identify trends in research on polymer materials of different genesis, with particular attention to research on the production and use of biopolymers. VOSviewer v.1.6.15 is used to present the analysis results. Environmental impact areas in the life cycle of traditional polymers have been analyzed. The network of main bioplastics clusters is visualized within the framework of modeling the dependencies on the main keywords in the analysis of the dynamics of publication activity, the main trends in the development of new biodegradable materials are revealed. A comparative review of the environmental impact of different types of bioplastics is made by the life cycle assessment method.

---

18:00 – 18:20 **Valencia-Arias et al.**

(Local Time Colombia 10:00 - 10:20)

**Research trends in household energy management systems: a bibliometric analysis**

**Alejandro Valencia-Arias, David Alberto García Arango,  
Jovany Sepúlveda-Aguirre, Cristina Ocampo-Osorio**

*Corporación Universitaria Americana, Barranquilla, Atlántico, Colombia  
Institución Universitaria ESCOLME, Medellín, Antioquia, Colombia*

World energy demand is constantly growing and inevitably entails the need to optimize processes for their best use. It is therefore necessary to identify the set of solutions that the scientific literature proposes on this topic, that's the reason why this article shows the results obtained from the application of a bibliometric analysis in the identification of research trends in relation to energy management systems in homes. Through the application of search equations in the Scopus database, the most published topics, the most cited articles and the authors' networks are found in order to identify emerging perspectives on the subject. As conclusion, the emerging themes with the greatest impact in the academic field and their practical implications in society and energy management are developed.

---

**18:20 – 18:40**    **Rojas**

*(Local Time: Colombia 10:20 - 10:40)*

**Identification of the offer for MOOC-type courses in the field of sustainable development: comparative analysis between social media and documentary results**

**Oscar Andrés Cuéllar Rojas**

*Corporación Universitaria Americana, Barranquilla, Atlántico, Colombia*

MOOC-type courses (and their variants) have managed to spread throughout the world, becoming the new promoters of changes in human relations, with the aim of establishing the starting point for the creation of courses under this approach in the field of s

---

**18:40 – 19:00**    **Estrada et al.**

*(Local Time Colombia 10:40 - 11:00)*

**Consumption decision of economic agents: cost vs. environmental awareness**

**Uvenny Quirama Estrada, Andrés Felipe Puerta Molina, Jovany Sepúlveda-Aguirre, Luis Fernando Garcés Giraldo, David Alberto García Arango**

*Corporación Universitaria Americana, Medellín, Antioquia, Colombia  
Universidad EAFIT, Medellín, Antioquia, Colombia*

Research aimed at the search for the sustainability of the planet through the development of environmentally friendly goods (green goods), has generally shown, in its marketing process, a cost higher than the sale price of a substitute good. conventional that does not equally satisfy the reduction of climate change. From the recognition of the average income per individual of a developing country and attending to the rational consumer microeconomic theory, where it seeks to maximize profit with the acquisition of goods at an optimal price and where satiety does not exist, This document, using a mixed exploratory type methodology, seeks to identify from behavioral economics, how willing is the existing demand in the market to the acquisition of a green good with a value higher than its substitute goods, and what are the characteristics of the individual that reflects within its consumption conditions the environmental benefit; at the end of the investigation, the data evidenced by the primary information acquired from surveys is concluded, which reflects conditions of the consumption decision based on age, income, educational level, among other aspects.

---

12:00 – 12:20 Deganello et al.

(Local Time Italy 11:00 - 11:20)

**Keynote Lecture\***

**Aluminum foil as a direct precursor for the solution combustion synthesis of  $\alpha$ -alumina**

**Francesca Deganello, Giacomo Messina,  
Giuseppe Marci, Maria Luisa Testa, and Valeria La Parola**

*Institute for the Study of Nanostructured Materials (ISMN), (Italian) National Research Council (CNR),  
Palermo, Italy*

*Department of Engineering (DI), University of Palermo, Palermo, Italy*

For the first time,  $\alpha$ -alumina powder was prepared by Solution Combustion Synthesis (SCS), using sucrose as a fuel and aluminum foil ("silver paper"), as aluminum source directly in the combustion mixture without any extractive pretreatment. Alumina, as  $\alpha$ -alumina, is a very important material from a technological and industrial point of view and it is used, in form of sintered bodies as ceramic support for circuits and membranes. Various synthesis methods have been adopted in the literature for the synthesis of alumina, including SCS. The most commonly used inorganic precursors for the synthesis of alumina are aluminum nitrate and aluminum chloride, although waste metallic aluminum from different origin was also used as a precursor, after dissolution by an extraction treatment, usually acidic. Our results show that a mild acidic treatment in the presence of sodium chloride was the key for promoting the interaction between aluminum and sucrose, whereas addition of a minimum amount of copper nitrate helps in the enhancement of the combustion process. Sodium chloride can be washed away before calcination or enter the alumina network during sintering at high temperatures. The procedure used in this work may also be applied to waste aluminum.

12:20 – 12:40 Tsybulskaya et al.

(Local Time: Russia 19:20 - 19:40)

**Instrumentation and features of producing the oleophilic sorbent on the perlite basis**

**Aleksandr A. Yudakov, Tatyana V. Ksenik, Oxana N. Tsybulskaya, Aleksey A. Kisel**

*Institute of Chemistry, Far Eastern Branch of the Russian Academy of Sciences, Vladivostok, Russia  
Far Eastern Federal University", Vladivostok, Russia*

The results of selection and justification for rational instrumentation of the technological process of producing the oleophilic sorbent on the perlite basis are presented. The description of the laboratory and experimental industrial plants is given. The temperature-time modes of the perlite modification process at all its stages are experimentally substantiated. The properties of the natural and modified perlite were investigated. The representativity of the established modes was proved by testing the pilot batches of the oleophilic sorbent in the course of sorption of oil products under laboratory and real conditions.

12:40 – 13:00 Yudakov et al.

(Local Time Russia 19:40 - 20:00)

**Eco-friendly technology of commercial components (titanium, gold) recovering**

**Vladimir Molchanov, Aleksandr Yudakov, Mikhail Medkov**

*Far East Geological Institute, Far Eastern Branch of the Russian Academy of Sciences, Vladivostok,  
Russia*

*Institute of Chemistry, Far Eastern Branch of the Russian Academy of Sciences, Vladivostok, Russia*

The main features of the mineralogy and geochemistry as well as the mining potential of the titanium placers spatially and genetically connected with the Ariadnensky intrusion of ultrabasites (Primorye) were determined. The composition of the ilmenite, gold and platinum was investigated and assemblage of the associated strategic metals was revealed. The possibilities of the commercial exploitation of ilmenite placers with the use of the environmentally acceptable methods of pyro-hydrometallurgy were assessed. The proposed technical solutions will allow us to expand the prospects of the raw-material base of the southern Far East of Russia in compliance with the principles of the sustainable nature management and environment protection.

\* Duration of the Keynote Presentations can be increased

**13:00 – 13:20 Baena-Moreno**

**(Local Time Spain 12:00 - 12:20)**

**Keynote Lecture\***

**Opportunities for CO<sub>2</sub> utilisation via carbonation**

**Francisco M. Baena-Moreno**

*Technical School of Engineering, University of Seville, Sevilla, Spain*

This study focuses on describing the most important aspects of CO<sub>2</sub> carbonation processes. Furthermore, a novel proposal for classifying CO<sub>2</sub> carbonation alternatives is presented. The technologies are classified into two main categories: mineral CO<sub>2</sub> carbonation; and hydroxides, salts and waste carbonation.

**13:20 – 13:40 Martinus et al.**

**(Local Time: Indonesia 17:20 - 17:40)**

**Development of Teak Leaf Plate Molding Machine for Producing Plastic Alternative Products**

**Martinus, Agus Haryanto, Sugeng Triono, Mareli Telaumbanua**

*University of Lampung, Bandar Lampung, Indonesia*

Single use plastic is one of the biggest problem in the world right now, it is the main source of non-degradable material in the world. The usage of plastic and plastic derivatives in Indonesia most times cannot be avoided as long as no alternatives products are available. Only a small portion of the plastic is recycled, the rest end up in the land and in the ocean. Plastic need hundreds of year to decompose and some even can't decompose like expanded polystyrene. A new machine is in need for in producing an alternative product for plastic. This machine is designed, develop and fabricated in Indonesia. PID control system is used to control both upper and lower die. Set points for both die can be set individually. The temperature of upper and lower die varies by different leaves and how many layer of leaves. The leaf plates made by the machine then tested along with plastic plates, expanded polystyrene plates and plastic laminated paper plates. The result of this test will conclude how good the leaf plates as an alternative for other disposable plates. Teak leaf plate molding machine is built and performing quite well. The temperature from upper and lower die can be controlled precisely. The plates that produce by the machine in tensile strength test also perform quite well. Teak leaf plates tensile break average at 29.3 N, slightly lower than plastic one and higher than expanded polystyrene one.

**13:40 – 14:00 Telaumbanua et al.**

**(Local Time Indonesia 17:40 - 18:00)**

**Design of insect trap automatic control system for Cacao plants**

**Mareli Telaumbanua, Agus Haryanto, Febryan Kusuma Wisnu, Budianto Lanya, Wahyu Wiratama**

*University of Lampung, Bandar Lampung, Indonesia*

Insect pests attacks on Cacao (*Theobroma cacao* L) plantations are generally controlled using chemical (non-organic) pesticides. Pesticides that are applied continuously can cause pest resistance, pest resurgence, and environmental pollution. Environmental pollution can disrupt the ecosystem due to increased toxic residues in plant tissue or the soil. Therefore, it is necessary to design a pest trap with charm and an automatic actuator based on a microcontroller on the Arduino board. This automatic insect trap is called the Teptrap v1. Five units of the infrared sensor type E18-D50NK are used to detect insect pests. The attractants used were TL lamps, yellow lights and attractants attached to the trap system. Teptrap v1 shows excellent performance during 33 days of research. As evidenced by the fan actuator system that works stably with a catching accuracy of 82.74%, insect drop time is 6 minutes 33 seconds, and the actuator response speed turns on the light, yellow LED and pumps <1 second ( $\pm 10$  mS). This insect pest control trap can reduce the use of spray pesticides by 20-50%, thereby saving the cost of purchasing pesticides up to IDR 74,468 per hectare of Cacao.

---

\* Duration of the Keynote Presentations can be increased

**14:00 – 14:20**    **Morais et al.**

*(Local Time Portugal 12:00 - 12:20)*

**Development of a monitoring device for fruit products transportation in the cold chain**

**Diogo Morais, Martim L. Aguiar, Pedro D. Gaspar, Pedro D. Silva,**

*University of Beira Interior, Covilhã, Portugal*

*C-MAST - Centre for Mechanical and Aerospace Science and Technologies, Covilhã, Portugal*

During food transport, products are often subject to conditions which do not benefit the conservation of their biological properties. This condition can lead to food quality and safety issues and ultimately to food waste. Globally, there has been an effort to develop techniques, procedures and technologies that can contribute to reduce food waste of perishable products such as horticultural ones. In this sense, remote monitoring systems, whose fundamental requirements relate to range and autonomy, make use of communications technologies to map characteristic crop parameters to reduce unnecessary application of resources or materials. This paper proposes a monitoring system to record the conservation conditions inside refrigeration plants and vehicles, transmitting them via the internet of Things (IoT). This device is composed of an ARDUINO UNO Rev3 microcontroller that acquires the environment temperature and relative humidity every 5 minutes by means of a DHT 11 sensor, and uses the SIM800L module that provides real time communication data via GSM. It also incorporates a 3.7 V – 2600 mAh battery that provides an approximate 60 hours power range.

---

**14:20 – 14:40**    **Aguiar et al.**

*(Local Time: Portugal 12:20 - 12:40)*

**Testing of a resistive sensor with fabric medium for monitoring frost formation in refrigeration systems**

**Martim L. Aguiar, Pedro D. Gaspar, Pedro D. Silva,**

*University of Beira Interior, Covilhã, Portugal*

*C-MAST - Centre for Mechanical and Aerospace Science and Technologies, Covilhã, Portugal*

Refrigeration is one of the key elements for food preservation. With global temperatures increasing due to global warming, the efficiency in refrigerated storage systems must be improved. One of the problems that is yet to be solved in these systems is the efficient and accurate removal of the frost formed on the heat exchanger surface. In previous works, a low-cost resistive sensor has been developed to detect frost formation for accurate removal. This paper shows the results of an experimental study carried out to increase the accuracy, by placing different configurations of a fabric medium in between the sensor electrodes.

---

**14:40 – 15:00**    **Kumar et al.**

*(Local Time Portugal 12:40 - 13:00)*

**Experimental tests of the thermal behaviour of new sustainable bio-packaging food boxes**

**Sasi Kumar, Fábio Leitão, Pedro D. Gaspar, Pedro D. Silva,**

*University of Beira Interior, Covilhã, Portugal*

*C-MAST - Centre for Mechanical and Aerospace Science and Technologies, Covilhã, Portugal*

This experimental task was performed using 8 sustainable Bio-Boxes in the thermal chamber in the laboratory. The air is forced from the refrigerator, and it is used to control the temperature inside the thermal chamber. The goal of the performed task is to evaluate the thermal behaviour of the bio Boxes made from different material, such as sugarcane bagasse and PLA material with respect to time. The test was performed to lower the temperature inside the chamber to its minimum air temperature inside the cold chamber. The results show that the SCB 4 has noticed changes in its mechanical properties (Tensile Strength) and it also shown some moisture absorbing when compared to other Bio boxes. Furthermore, this kind of Bio packaging materials needs more research to improve their mechanical and barrier properties and minimise the use of plastic containers for food packaging industry.

---

15:00 – 15:20 **Kryvenko**

(Local Time Ukraine 15:00 - 15:20)

### **Emissions of pollutants into the atmospheric air by stationary sources**

**Galyna Kryvenko**

*Ivano-Frankivsk National Technical University of Oil and Gas, Ivano-Frankivsk, Ukraine*

Oil and gas companies are one of the main sources of man-made hazards associated with the emission of extremely harmful substances and extreme situations. Emissions of harmful substances during the operation of oil and gas facilities complicate the environmental situation. Environmental issues are always actual. The purpose of this work is to analyze the dispersion of pollutant emissions into the atmosphere by stationary sources. The research was addressing the issues of analysis of ground-level concentrations of pollutants within a sanitary protection zone. The object of the study is the enterprises of the oil and gas complex, the subject of the study is the estimation of emissions of harmful substances into the atmosphere by stationary sources. Emissions of pollutants were calculated using a Gaussian statistical model. Mathematical models for the determination of lateral and vertical diffusion coefficients were constructed. The analysis of pollutant emissions into the atmospheric air by stationary sources of different altitudes was performed. It is established that the concentration of the pollutant from the source decreases monotonically. The bulk of impurities is concentrated in a relatively narrow jet. The lower the source, the closer to it the maximum concentration of air pollutants is, resulting in a negative impact on the health of service personnel.

---

15:20 – 15:40 **Belokon et al.**

(Local Time: Ukraine 15:20 - 15:40)

### **Optimal composition of intermetallic catalyst for neutralization of carbon-containing components of gas emissions**

**Karina Belokon, Volodymyr Pohrebennyk, Artem Sybir, Yevheniia Manidina, Andrii Banakh**

*Zaporizhzhia National University, Engineering Educational and Research Institute, Zaporizhzhia, Ukraine*

*Lviv Polytechnic National University, Lviv, Ukraine  
National Metallurgical Academy of Ukraine, Dnipro, Ukraine*

The paper presents the results of the optimization of intermetallic compounds used for catalytic neutralization of carbon-containing exhaust gases. The statistical method of designing active experiments was used to analyze the effect of cobalt, manganese and copper on the catalytic, physical and chemical properties of the catalyst. The catalytic activity, specific surface area, and porosity of the catalyst were taken as the response function. The experimental data were mathematically processed using regression analysis. The work used a symmetric composition second-order design. As a result of mathematical programming, regression equations were obtained that describe the effect of the cobalt, manganese and copper content on the catalytic properties and porosity of the catalyst, and the response surfaces. The optimal combination of catalytic, physical and mechanical properties ensures that the compound contains 30% of nickel, 10% of cobalt, 11% of manganese and 2% of copper. When using such intermetallic compound, the conversion of carbon monoxide is 100%, and that of propane is 95 %, the specific surface area of the obtained catalyst is 110 m<sup>2</sup>/g, and the porosity is 64 %. The error of the regression equations did not exceed 2%.

---

15:40 – 16:00 **Mosiyevych et.al**

(Local Time Ukraine 15:40 - 16:00)

### **The physical and mechanical properties of intermetallic catalysts for the neutralization of carbon-containing components of emission gases**

**Karina Belokon, Yevheniia Manidina, Aleksandr Fedchenok, Andrii Banakh, Larysa Mosiyevych**

*Zaporizhzhia National University, Engineering Educational and Research Institute, Zaporizhzhia, Ukraine*

The analysis of the study results of the physical and mechanical properties of intermetallic catalysts showed that they differ depending on their composition and processing method. The difference in the physical and mechanical properties of the catalysts is explained by differences in their structure, phase composition, porosity and pore size. When manganese is added, the porosity of the catalyst increases as a result of an increase in the volume of large pores while the structure of small capillaries does not change due to the localization of manganese oxide in the catalyst's pores. Yet, the mechanical strength decreases and can be increased if the copper alloy is added in the Ni-Co-Mn catalyst. A major benefit of thermal self-ignition is that the catalyst's strength is 50% higher than that of sintered materials with the same porosity. High temperatures of the process and low impurity content at the grain boundaries (due to self-cleaning) lead to the formation of strong bonds between grains in the crystallite. The average specific surface area for all investigated catalyst samples is 112 m<sup>2</sup>/g.

---

**16:00 – 16:20 Manidina et al.**

**(Local Time Ukraine 16:00 - 16:20)**

**Using plasma catalysis for oxidation of sulphur dioxide to sulphur trioxide**

**Yevheniia Manidina, Karina Belokon, Nataliia Berenda, Olena Troitska**

*Zaporizhzhia National University, Zaporizhzhia, Ukraine*

The paper researches the influence of the main properties of streamer discharge on the conversion of sulphur dioxide into sulphur trioxide and the effect of gas exposure to a streamer discharge for the oxidation of sulphur dioxide. It has been defined that the change of peak to peak voltage has the most impact on the efficiency of sulphur dioxide capture. It has been found out that delivery of voltage pulses with a period of 1ms allows having the conversion rate of sulphur dioxide at about 96.7%. It has been detected that with the pulse duration of 350 ns the conversion rate of sulphur dioxide is 98.6%.

---

**16:20 – 16:40 Zhang**

**(Local Time: USA 09:20 - 09:40)**

**Keynote Lecture\***

**Membrane technologies for CO<sub>2</sub> capture**

**Zhien Zhang**

*The Ohio State University*

CO<sub>2</sub>, as a major greenhouse gas emission, has attracted the global attention. In order to achieve the CO<sub>2</sub> reduction target by 2050, carbon capture technologies have been widely investigated all over the world. Membrane technology as an emerging approach is used to capture CO<sub>2</sub>. Compared with the conventional amine method, membrane technology provides modularity, flexibility and no flooding, foaming or entrainment. In this work, membrane gas absorption (MGA) technology is proved to capture more than 95% CO<sub>2</sub> from the power plant flue gas. This technology shows great potentials to remove CO<sub>2</sub> and other acidic gases from biogas, syngas, natural gas, and coalbed methane.

---

\* Duration of the Keynote Presentations can be increased

14:00 – 14:20 **Zhelnovach et al.**

(Local Time Ukraine 14:00 - 14:20)

**Researching the degradation of roadside plant communities**

**Ganna Zhelnovach, Karina Belokon, Yevheniia Manidina, Inna Tkalich**

*Kharkiv National Automobile and Highway University, Kharkiv, Ukraine  
Zaporizhzhia National University, Zaporizhzhia, Ukraine*

Biodiversity loss is one of the global problems of mankind. The article studies the impact of the road use on biodiversity loss and, as a result, the degradation of plant communities which occupy large areas and are the basis of ecosystem development. It is defined that they degrade due to man-made soil salinisation, physical vegetation destruction, dust and chemical pollution. The paper assesses the level of such degradation of the roadside plant community at the representative road section in terms of quantity and quality. A significant level of destructive impact has been detected which results in the loss of species composition, displacement of glycophytes by halophytes, reduction of grass density by over 70 % compared to the checkpoint as the highway nears. Practical approaches to the development and implementation of a roadside vegetation management system are proposed.

14:20 – 14:40 **Triyono et al.**

(Local Time Indonesia 18:20 - 18:40)

**Effects of organic compost doses and regulated irrigation on growth and yield of organic Red Rapid Lettuce (*Lactuca sativa* L var. Red Rapids)**

**Sugeng Triyono, Aldi Riski Wibowo, Dermiyati, Jamalam Lumbanraja**

*University of Lampung, Bandar Lampung, Lampung Province, Indonesia*

Organic vegetables have gotten an increasing interest, but organic fertilizers and irrigation water used to produce them could be significant issues of economic calculation to be considered for some locations. This study was aimed to determine the optimum doses of organic compost and irrigation level for growing organic red lettuce in a greenhouse. Completely Random Design (CRD) coupled with factorial arrangement was implemented in this study. Treatments consisted of two factors; doses of organic compost (D) and regulated irrigation levels (I). The factor of doses included 0% (D0), 10% (D1), 30% (D2), and 50% (D3) organic compost of the total weight of the growth media (3 kg per pot). The factor of regulated irrigation levels included 40% (I1), 70% (I2), and 100% (I3) of available water. Three replicates were used, making total of 36 experimental units. Plants were cultivated in a greenhouse, using pots each of which contained 3 kg media, and watered regularly based on the treatments assigned. The data set was analyzed by using Analysis of Variance (ANOVA) and followed by least significant differences (LSD) at  $\alpha = 5\%$ . The result showed that Effect of interaction between organic compost doses and irrigation levels on the growth, yield, and water productivity of the red rapid lettuce was significant at  $\alpha = 0.05$ . However, the treatments were not significant on some chemical properties of the rapid red lettuce. The most optimum scheme was found to be the treatment combination between the organic compost dose of 300 g plant<sup>-1</sup> (D1) and the regulated irrigation level at 100% (I3) of available water.

14:40 – 15:00 **Harahap et al.**

(Local Time: Indonesia 18:40 - 19:00)

**Active versus passive cooling systems in increasing solar panel output**

**R. Harahap, S. Suherman**

*Universitas Sumatera Utara, Medan, Indonesia*

Energy availability will remain an issue whole years as energy is the primary human need to live in this planet. Fossil energy is no longer the primary choice as its availability decreases every year, although it dominates the energy source used today. Solar cell is increasingly installed throughout the world even though initial cost is still expensive for many developing and poor countries. For them who have connected the solar system generators to grid, sunlight to electrical conversion efficiency is the primary concern. On the other hand, system output optimization such as by using maximum power tracking method and cooling system are non material efficient solutions. Maximum tracking system may be costly as mechanical system should be developed well for large solar system. Cooling system on the other hand, is much simpler but limited in efficiency increment. Even though, beside efficiency increment, the cooling system assists system to avoid excessive surface temperature, which in some cases may lead to panel destruction. The active cooling system requires some electric current from the solar panel output to enable cooling system works. The system achieves better surface temperature reduction than passive cooling system, but the current absorption should be as low as possible to avoid deficiency. This work proposed water based cooling system energized by batteries and compared the output performance to passive cooling system. The result shows that the periodic water sprinkler results better temperature decrement about 13.6% higher power than passive cooling system for sprinkler period of 20 minutes and sprinkle duration of 20 second. The performance decreases when sprinkler period is set 60 minutes. By using the applied water tank, water is available up to 24 hours for sprinkle period of 20 minutes but last longer for 60 minutes. Horizontal sprinkler position results larger cooled area than vertical position which generates 2.45% higher output power.

**15:00 – 15:20**    **Adoniev et al.**    *(Local Time Ukraine 15:00 - 15:20)*

**Increasing the uniformity of metal heating in chamber furnaces by influence of the electric field**

**Andrii Cheilytko, Yevhen Adoniev, Alina Yerofieieva**

*Zaporizhzhia National University, Zaporizhzhia, Ukraine*

The article is devoted to the possibility of increasing the energy of efficiency of gas chamber furnaces. For high-quality metal heating in a chamber furnace is proposed to use spatial electric field. It is empirically proved that there are optimal values of electric field control factors for chamber furnaces with a pull-out hearth, which reduce fuel consumption and produce quality of heating of metal, namely: high uniformity of heating.

---

**15:20 – 15:40**    **Yousef et al.**    *(Local Time Russia 15:20 - 15:40)*

**Experimental investigation of a two-zone dry low emission gas turbine combustor**

**Wisam Yousef, Vitaliy Sychenkov, Nikolay Davydov, Vladislav Varsegov, Ruslan Khaliulin**

*A.N.Tupolev Kazan National Research Technical University – KAI, Kazan, Russia*

A new design of a two-zone combustor with sequentially located pilot and main zones is described. The pilot zone provides: the required range of stable combustion at leaner conditions, heating and initiation of combustion in the main zone. The main zone provides burnout of the fuel-air mixture at leaner conditions with low emission values. Combustion in both zones is formed by supplying air through the double tangential swirlers with co-rotation in the pilot zone and counter-rotation in the main zone, while the fuel is supplied between the swirlers vanes. It is shown that the investigated combustor ensures the simultaneous minimization of emissions (CO and NO<sub>x</sub>) at acceptable values of non-uniformity of the outlet temperature field and a wide range of stable combustion.

---

**15:40 – 16:00**    **Evdokimov et al.**    *(Local Time: Russia 15:40 - 16:00)*

**Emission characteristics of bidirectional vortex combustors operating on gaseous, liquid and pulverized solid fuel**

**Oleg Evdokimov, Alexander Guryanov, Sergey Veretennikov**

*Soloviev Rybinsk State Aviation Technical University, Rybinsk, Yaroslavl Region, Russia*

The paper reports on a comparison of emission characteristics in the bidirectional vortex combustor operating on different types of fuel. Gaseous propane, liquid kerosene, and solid pulverized peat are suggested. It is shown that emission curves differ from classical ones corresponding to gas turbine combustion. Comparative analysis of the emission curves shows that NO<sub>x</sub> emission is similar for all three fuel types whereas CO emission differs significantly. The use of all types of fuel gives minima of CO emission for lean combustion. However, optimal ranges for solid and liquid fuel are smaller than for gas because of the strong influence of evaporation and devolatilization processes. Additionally, there is an increase in CO emission for kerosene and peat above the upper limit of the optimal  $\lambda$  range which corresponds to the most environmentally friendly combustion. CO emission for gaseous fuel remains minimal up to the lean flameout boundary.

---

**16:00 – 16:20**    **Isaza-Ruiz et al.**    *(Local Time Colombia 08:00 - 08:20)*

**Thermal properties of hitec salt-based nanofluids synthesized by new two-step method**

**Marllory Isaza-Ruiz, Francisco Bolívar Osorio**

*Centro de Investigación, Innovación y Desarrollo de Materiales CIDEMAT, Medellín, Colombia*

The use of molten salt-based nanofluids as a thermal storage medium, the evaluation of their thermophysical properties, and the development of new more efficient synthesis methods, have attracted great interest from researchers. In this way, this work focuses on the development of a new two-step method in which the use of water in the process is eliminated, without affecting the stability and homogeneity of the particles within the salt. Molten salt-based nanofluids with Hitec as base fluid and alumina nanoparticles as an additive in three different proportions 0.5, 1.0, and 1.5 wt% with a 13.6 nm nominal size. The thermal properties, melting point, specific heat capacity, and thermal stability were evaluated, as well as, the microstructural analysis to determine the good distribution of the nanoparticles in the salt. The increase of up to 14.6% of the specific heat of the molten salt-based nanofluids compared to the base salt, as well as the decrease in the

melting point without affecting the thermal stability demonstrate the viability of the proposed method for the synthesis of nanofluids for thermal energy storage in CSP plants.

---

**16:20 – 16:40**    **Guryanov et al.**

*(Local Time Russia 16:20 - 16:40)*

### **A study of multifuel bidirectional combustor**

**Alexander Guryanov, Oleg Evdokimov, Sergey Veretennikov, Marina Guryanova**

*Soloviev Rybinsk State Aviation Technical University, Rybinsk, Yaroslavl Region, Russia*

The results of experimental studies of the multifuel liquid-gas combustion in the bidirectional vortex combustor are presented. Propane is used as gaseous fuel and kerosene is used as the liquid. The transition between fuels of the different states of matter and molecular mass defines a change in flame geometry and combustion zone length. Depending on the degree of the airflow expansion, the experimentally measured values of the lean limit of stable combustion correspond to the range of the air-fuel equivalence ratio from 3.3 to 7.0. Additionally, the bidirectional vortex combustor provides sufficient stability at the repetitive transitions “liquid-to-gas-to-liquid”. Measured values of the total thermal power of the combustor at five consecutive transitions define a change in the total thermal power of no more than 3%.

---

**16:40 – 17:00**    **Kovalnogov et al.**

*(Local Time: Russia 17:40 - 18:00)*

### **Simulation of the processes of combined fuel combustion and analysis of harmful substances emission**

**Vladislav Kovalnogov, Ruslan Fedorov, Andrei Chukalin, Usama Mizher**

*Ulyanovsk State Technical University, Ulyanovsk, Russia*

Prevention of further atmospheric air pollution and reduction of toxic substances emission is one of the goals of state policy in the field of energy. In this regard, the search for new solutions that prevent negative impact on the environment is one of the priority tasks for modern society. An alternative, but less efficient fuel compared to natural gas is biogas extracted from organic waste. The high content of carbon dioxide in biogas reduces the calorific value, while flame detachment from the burner is also observed. One of the promising options for reducing the negative impact of energy on the environment is the combined burning of natural gas and biogas. For the combined burning of natural gas and biogas in operating power-generating boiler, it is necessary to reconstruct the burner devices installed on them. For a high-quality reconstruction of burner devices, it is important to have theoretical data on the effect of combustion combinations on the content of toxic combustion products in the flue gases of power-generating boilers. In this paper, a turbulence model  $k - \epsilon$  (realizable) is presented, which allows simulating the combustion process of a fuel-air mixture. The quantitative content of NO<sub>x</sub>, CO<sub>2</sub> in the products of combustion of fuel combinations - natural gas, biogas, natural gas / biogas is presented.

**17:00 – 17:20**    **Pérez et al.**

*(Local Time Colombia 09:00 - 09:20)*

### **Implementation of clean production in cups and dishes with coffee grounds**

**Daniel Alberto García Pérez, Hanleidy Ibarguen Zúñiga, Alex Aparicio Alvarado Díaz, Anderson Manuel Trespalacio González, David Alberto García Arango**

*Corporación Universitaria Americana, Barranquilla, Atlántico, Colombia*

In this paper, a methodology for the sustainable creation of MDF-type products based on coffee beans is presented. This type of production must be profitable, sustainable and environmentally friendly. Therefore, the relationship between the biomass content and drying temperature of the medium density chipboard plates and the physical characteristics that have low time and constant drying pressure is determined. For this purpose, an experiment is carried out at the laboratory level to determine the relationship between biomass at different levels of binders in a percentage way with respect to coffee grounds, in specimens of a size already determined for experimentation. This process makes possible to determine possible differences in levels of similarity with respect to a wooden MDF pattern.

---

**17:20 – 17:40 Chernyavskyy et al. (Local Time Ukraine 17:20 - 17:40)**

**Scientific bases, experience of production and combustion of coal mixtures at thermal power plants of Ukraine**

**Mykola Chernyavskyy, Oleksii Provalov, Oleksii Kosyachkov, Igor Bestsenny**

*Coal Energy Technology Institute (CETI) of National Academy of Sciences of Ukraine, Kyiv, Ukraine*

It is substantiated that in conditions of termination of supplies of Donetsk anthracite the expansion of fuel base of anthracite power units, which make up half of generating capacities of thermal power plants (TPPs) of Ukraine, is possible due to use of mixtures of anthracite with local bituminous coal and petroleum coke. The issues of production, pulverizing, combustion of mixtures and environmental aspects of their use are considered. Based on the numerical analysis of the ratio of specific combustion rates of fuels, it is shown that 30-35% of bituminous coal significantly contribute to the ignition and combustion of anthracite in the pulverized coal flame. The criteria of homogeneity of mixtures are established and the methods of production and testing the homogeneity of mixtures at the TPP coal storage place are worked out. The experience of coal mixtures combustion at three power plants of Ukraine is generalized.

---

**17:40 – 18:00 Repelewicz et al. (Local Time: Poland 16:40 - 17:00)**

**Gypsum composites with woodchip and sawdust fillers**

**Aleksandra Repelewicz, Katarzyna Regulska**

*Czestochowa University of Technology, Czestochowa, Poland*

Gypsum composites have been gaining increasing interest during last years. The focus on increasing their production in Poland results from the rich, countrywide natural gypsum sources and the growing amounts of synthetic gypsum derived from flue gas desulfurization in domestic power plants. Nowadays, the environment-supporting options are in game. Comparison of results of tests concerning the physical and mechanical properties of gypsum composites with organic fillers: wood sawdust and chips is described in the paper.

---

**18:00 – 18:20 Peceño et al. (Local Time Chile 12:00 - 12:20)**

**Influence of particle size of mussel shells in physical, mechanical and insulating properties of fireproof materials**

**Begoña Peceño, Bernabe Alonso-Fariñas, Celia Arenas, Carlos Leiva**

*Universidad Católica del Norte, Coquimbo, Chile  
Universidad de Sevilla, Seville, Spain*

In this study, the behavior of mussel shell as a component of passive fire protection materials was evaluated. To investigate the performance of mussel shell waste, different gypsum replacement ratios were analyzed from 40 to 80 %wt. Two different kinds of shells, separately or as a mix, were employed. In addition, two different particle size distributions, smaller than 320 µm and bigger than 320 µm, were used. Physical, mechanical, insulating capacity and leaching properties were thoroughly analyzed. Our results indicate that replacements lower than 60 %wt comply with all mechanical demands and have no reduction in insulating capacity. Additionally, no leaching problems were detected. Mortars made by combination of mussel shell and gypsum have the potential to be used as a component in construction materials for passive protection against fire.

---

**18:20 – 18:40 Oliveira et al. (Local Time Brazil 11:20 - 11:40)**

**A new microbicial pervious concrete pavement to be used in hospital parking-lots: assessment of the modulus of elasticity by the finite element method**

**Evailton Arantes de Oliveira, Justice Kofi Debrah, Maria João Correia de Simas Guerreiro, Maria Alzira Pimenta Dinis**

*University Fernando Pessoa, Porto, Portugal*

In the coronavirus pandemic (COVID-19), it is important to articulate a safeguard against urban contamination originating from hospitals, mainly the tires of vehicles that travel in the hospital parking-lots and contaminating the various parts of the city through traffic on urban roads. With the purpose of disinfecting the pavement of hospital parking-lots to prevent diseases, this research proposes the use of a new pavement composed of pervious concrete

with calcium hydroxide (Ca(OH)<sub>2</sub>) additive, i.e., lime powder. The well-known powder lime becomes a disinfectant with a microbicidal effect which increases the pH of the pavement, being a low cost and an abundant material. Studies have shown that this additive affects the mechanical strength of pervious concrete when added to its mixture. Accordingly, the objective of the study is to find a balance between mechanical strength and the ideal proportion of lime powder additive in the pervious concrete mixture through finite element prototypes subjected to vertical loads of 10,000 N with variation in the modulus of elasticity. The results of the structural simulations indicate the prototype with the best performance ratio is 1:0.8:4 (cement:Ca(OH)<sub>2</sub>:limestone), compressive strain of 15.70 kg/cm<sup>2</sup>, density of 1,971.42 kg/m<sup>3</sup> and modulus of elasticity of 1,480.22 MPa, with demonstrates a satisfactory mechanical performance for the use of this new pavement in hospital parking-lots.

---

**18:40 – 19:00**

**Guryanov et al.**

**(Local Time: Russia 18:40 - 19:00)**

**The structure of nonreactive bidirectional and direct swirling flows and its effect on mass transfer intensification and mixing efficiency**

**A.I. Guryanov, A.V. Kosonogova, M.M. Guryanova, O.A. Evdokimov, S.V. Veretennikov**

*Soloviev Rybinsk State Aviation Technical University, Rybinsk, Yaroslavl Region, Russia  
Public JSC "UEC-Saturn", Rybinsk, Yaroslavl Region, Russia*

One of the most promising methods of low-emission methane combustion is in a lean fully pre-mixed flame. A key characteristic of such an (non-stoichiometric) approach is the ability to directly control the air-to-fuel ratio. This can be achieved in the pre-mixing stage of fuel and oxidizer. The focus of the present paper is to study uniformity of fuel distribution in fully pre-mixed flame module of a concept lean bi- and mono-directional fuel- and air-flow combustion chamber. Numerical and experimental studies of fuel and air mixing have been carried out. Four configurations were considered, differing in presence/absence of flow swirl and relative flow directions of mixing components. It is found that the configuration with highest mix uniformity is one with bi-directional swirling air-flow with respect to injected fuel.

---

**19:00 – 19:20**

**Moumane et al.**

**(Local Time Ukraine 19:00 - 19:20)**

**Specifics of coal-water fuel heat transfer at the fuel pre-heating stage**

**Valeriya Pinchuk, Mohammed Moumane, Tatiana Sharabura, Yulia Shishko, Andrey Kuzmin**

*National Metallurgical Academy of Ukraine, Dnipro, Ukraine  
Institute for Engineering Thermal Physics of National Academy of Sciences of Ukraine, Kiev, Ukraine*

Renewable energy sources are currently unable to meet the growing energy demand. Therefore, fossil fuels are continued using for energy generation. Coal is one of the most used resources for this purpose. However, its combustion leads to huge environmental pollution. The usage of coal in the form of coal-water fuel allows significantly decreasing the volume of harmful emissions. Scientific research in this area became of high-interest last decade. The usage of coal-water fuel requires some preparations and activation of the fuel before combustion. One of the preparation stages is coal-water fuel's thermal activation which improves the burning processes of such a fuel. This manuscript considers specifics of the coal-water fuel pre-heating in the feeding pipe. The results show that wide used Graetz solution for Newtonian fluids cannot be used for calculation of the heat-transfer parameters in the case of coal-water fuel. An empirical equation was obtained for use in practical applications

---