



CHEMICAL AND TECHNOLOGICAL SYSTEMS

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MULTIFUNCTIONAL APPLICATION OF PLANAR 2D MOLECULE FOR LIGHT-EMITTING HETEROSTRUCTURES

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The object of research is the donor-acceptor compound, organic and hybrid heterostructures based on it. The paper is focused on a comprehensive approach to solving the problem of the efficiency of light-emitting devices, finding new technological and design solutions for the use of organic compounds as multifunctional materials for various types of light-emitting devices.

The paper presents the multifunctional application of a planar 2D molecule as an emission layer for typical and inverted types of light-emitting heterostructures, as well as a matrix for a host-guest system using inorganic quantum dots. The developed light-emitting structures are characterized by external quantum efficiency typical for fluorescent devices, but good stability over the entire length of the consumption voltage. QLED brightness is 1600 cd·m⁻² and EQE 1.4 %, which are good parameters for use in display technology.

Organic LEDs based on planar molecules are promising candidates for use in modern lighting systems. A separate advantage of these light-emitting structures is the multifunctionality of using one compound for different types of light-emitting structures, including inverted heterostructures. Special attention is paid to the technological and design implementation of invert structures, since their geometry allows direct connection to the back board of the n-channel transistor on the substrate. In addition, organic LEDs have low energy consumption and are environmentally friendly due to the absence of toxic substances in their architecture, which creates the prerequisites for saving energy resources and reducing the industrial burden on the environment.

Keywords: organic light-emitting diodes, OLED, inverted OLED, quantum dots, electron-hole emissive recombination.

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ANALYSIS OF THE SETTLING PROCESS TO IMPROVE THE QUALITY OF PHOSPHATE PRODUCTS OF THE DJEBEL ONK DEPOSIT

pages 11–17

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The object of the study is the phosphates of the Djebel Onk region, which are part of a vast group of phosphate deposits formed in the Late Cretaceous-Eocene period on the South and Southeast Mediterranean shores. These concentrations of economic interest are operated near the town of Bir El Ater (Tebessa, Algeria). The mining industry based on the extraction and processing of different minerals while respecting the environmental framework plays an important role in the economy of a country. The economic potential of each country will be determined based on the level of production of metals and various mineral substances. In the case of the Djebel Onk phosphate ore, the most dominant mineral in addition to P_2O_5 is calcium carbonate $CaCO_3$ with more than 50 % in the all-mineral content. In addition, phosphate concentrate contains harmful elements which reduce the value of the market product. Therefore, this study aims to recover the enriched product efficiently and profitably with a minimum of deleterious elements. This work aims to develop a treatment technology with a minimum rejection rate, which allows for achieving production goals and reducing environmental impacts. For this purpose, we proposed an enrichment of these phosphate discharges from the settling process utilizing pneumatic selection (Turbo Separator Ventilate – TSV). The results of the chemical analyses confirm the significant difference in useful and major elements (P_2O_5) and the minor and harmful elements (MgO). According to the granulochemical analysis of each slice, it is possible to note that the P_2O_5 content is similar to the various particle-size slices. It is therefore necessary to treat the mass of waste if we want to recover as much phosphate as possible. The obtained X-ray diffractograms highlighted appreciable differences between the raw phosphates and the concentrates, in fact, the qualitative and quantitative variation of the mineralogical species, particularly the calcite, quartz, dolomite, and apatite. TSV is a process used to improve the quality and quantity of phosphate and to eliminate the layer below 0.8 mm. Corresponding to the analyses it was appeared that the P_2O_5 content 29.5–30 % of the settled product increases to 30.2–31 % after dust removal. Then it is possible to achieve an increase in the quality of phosphate from 63/65 % TPL to 66/68 % TPL.

Keywords: phosphate ores, settling process, TSV, major elements, quality improvement, Tebessa, Southeast Algeria.

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EVALUATION OF THE EFFECT OF AIRPLANES ON THE ENVIRONMENT ON THE EXAMPLE OF BOEING 747 AND BOEING 757

pages 18–24

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The object of research is the impact of airplanes on the environment. Aviation is an area of our life that has been developing faster and faster every year for more than a century. Accordingly, aircraft have a negative impact on the surrounding natural environment, and therefore the assessment of their impact on nature and people is an important and integral component of research in the field of ecology and sustainable development. In particular, the airplanes produced by Boeing are among those that are most widely used in both passenger and cargo air transportation, so a study was conducted on their example.

In the study, calculation methods were used to estimate the load on the surrounding natural environment from the operation of Boeing 747 and Boeing 757 aircraft, based on the declared characteristics of emissions from the engines of these aircraft.

The study shows that every aircraft has a certain negative impact on the environment due to the emission of pollutants during all

phases of flight. However, there are opportunities to minimize this impact by implementing more complete fuel combustion, replacing standard fuels such as aviation kerosene with more modern fuels, reducing the weight of the aircraft, which will lead to lower fuel consumption and, accordingly, lower emissions into the atmosphere. Also effective is the introduction of technologies to reduce the noise load from the operation of aircraft, such as the introduction of noise-protective coverings of runways, new materials for the production of aircraft engines, as well as changing the design of engines and the use of double-circuit scheme.

The work assessed the impact of aircraft on the environment and the effectiveness of environmental protection measures using the example of the operation of Boeing 747 and Boeing 757 aircraft, and developed proposals for the implementation of environmental protection and technical measures to reduce this impact.

Keywords: emissions, Boeing aircraft, environment, noise pollution, environmental pollution.

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ASSESSMENT OF THE OPPORTUNITIES OF DEMOLITION WASTE USING AS A BUILDING MATERIAL OF THE FUTURE IN UKRAINE

pages 25–29

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The object of research is the potential of secondary use of waste from the destruction of buildings and structures, which were formed as a result of the military aggression of the Russian Federation on the territory of Ukraine. For Ukraine, the issue of demolition waste is critical at the level of environmental safety and ensuring the demand for building materials for the reclamation of Ukraine according to the principles of the circular economy. To date, there are no official methods that would allow to determine the exact amount of destruction and the quality of the material formed, which complicates the development of mechanisms for its utilization in production. The key industry considered during the research for disposal of demolition waste is the industry of construction materials production.

In the course of research, it was determined that most of the generated waste is waste from the destruction of buildings and structures made of precast concrete, however, considering that these wastes are generated by the action of explosions from shells. It is very difficult to ensure their compliance with the requirements of current standards due to the inclusion that such waste can contain. Therefore, the problem considered by this study is the determination of the nature of waste from the destruction of buildings and structures, their physical, mechanical and chemical characteristics, in the context of the final applications of products based on them.

The results of the study showed that when reproducing the concrete mix for tared concrete for civil purposes, which do not have high requirements for stability in aggressive operating conditions, when replacing natural aggregate crushed to a fraction of 5 to 20 mm,

the requirements for concrete strength are achieved in the level of C40/50 strength class. But the rheological characteristics deteriorate due to the high absorption of water from the concrete mixture by the studied material. Research has shown that for further use in the production of ready-mixed concrete and precast concrete products, it is necessary to prepare demolition waste with a wide particle size distribution and low dust content. This can ensure a high level of recycling and meet the demand for concrete in the reconstruction of Ukraine. The fine aggregate from the demolition waste crushing process can be considered as secondary cementitious material for cement production.

Keywords: construction and demolition waste, recycled concrete aggregates, ready mixed concrete, debris, building materials.

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ANALYSIS OF REFRIGERANTS USED IN SUPERMARKET COMMERCIAL EQUIPMENT AND THE POTENTIAL FOR INCREASING ENERGY EFFICIENCY AND REDUCING ENVIRONMENTAL IMPACT

pages 30–35

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Refrigerants used in the commercial equipment of supermarkets are the object of the research. The Montreal Protocol calls for a complete phase-out of hydrochlorofluorocarbons (HCFCs) by 2030, and the Kigali Amendment regulates the use of hydrofluorocarbons (HFCs) from 2019. Developed countries began phasing out HFC use in 2019, while developing countries plan to freeze HFC consumption from 2024. These global efforts are aimed at reducing the depletion of the ozone layer and combating climate change. The number of supermarkets in the world varies greatly: in Europe they number from 110 thousand to 115 thousand, and in China – from 65 thousand to 70 thousand, which reflects various needs in refrigeration equipment. Stringent environmental regulations are forcing the commercial refrigeration sector to remain globally competitive. Modernization of supermarkets using natural refrigerants is important for solving emerging challenges. The results of the study show significant improvements in energy efficiency ratio (EER) and coefficient of performance (COP) when using a mixture of hydrocarbons (R290: 85 %, R600a: 15 %) compared to traditional refrigerants R404a, R449a and R502. Specifically, at the evaporation temperature of $T_{evap} = -10$ °C, EER increased by 38–44 % and COP by 26–31 % compared to R404a and R449a, respectively. At $T_{evap} = -25$ °C, EER increased by 17–34 % and COP by 2–22 % compared to R404a and R449a. Additionally, compared to R502, the hydrocarbon blend showed a 38–44 % increase in EER and 28–31 % COP at $T_{evap} = -10$ °C, and a 17–34 % increase in EER and 5–22 % COP at $T_{evap} = -25$ °C. These results highlight the advantages of the hydrocarbon mixture at different evaporation temperatures, indicating its potential to improve energy efficiency in refrigeration applications. The obtained data suggest the possibility of a wider application of the mixture of hydrocarbons in commercial refrigeration plants, offering both improved performance and compliance with safety regulations.

Keywords: propane, isobutane, refrigerant, hydrocarbons and their mixtures, fire hazard, commercial refrigeration equipment.

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ANALYSIS OF THE WORLD MARKET OF WASTE MANAGEMENT

pages 36–43

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This paper provides an overview of the solid waste management market, which is the object of the study, including the processes of collection, transportation, utilization and recycling, supervision and monitoring of these processes. The volume and dynamics of the global waste management market in 2023 and its forecasting until 2033 are considered. The problem solved in the article is to identify the key factors of influence and interconnection on the development of waste management market components to determine the directions of an effective sustainable development policy. The author analyzes the methods of waste management in different European countries and identifies the key factors influencing the market dynamics: the effects of urbanization, environmental regulations, waste-to-energy technologies, circular economy initiatives, smart waste management systems, increased waste recycling, and the development of green infrastructure. It is determined that the growing awareness of environmental problems and increasing public pressure are leading to an increase in government investment in the development of innovative technologies for effective waste management. It is established that the promotion of recycling infrastructure and the implementation of campaigns aimed at raising awareness among the population leads to an increase in the importance of responsible waste management, the introduction of public-private partnerships in the field of waste management and the development of green infrastructure. The market is analyzed by region, end user, and waste type. According to the regional analysis, North America has the largest market share, but Asia Pacific is showing the fastest growth. North America has a large waste management market due to its developed infrastructure and high level of environmental awareness. However, Asia-Pacific, particularly China and India, is emerging as a growth center due to rapid economic development, population growth, and rapid urbanization, indicating the potential for new waste management markets in this region. According to the analysis by waste type, industrial waste is the largest category, with the electronic segment showing dynamic growth. This analysis allows to forecast the market and trends in the waste management industry, which makes it possible to calculate costs and profits, scale global trends to Ukrainian realities, and offer promising investment opportunities, which is especially important in the times of recovery of Ukraine.

Keywords: waste management, recycling technologies, end-user, waste type, green investment, waste market, sustainable development.

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FOOD PRODUCTION TECHNOLOGY

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ANALYSIS AND ASSESSMENT OF POTENTIAL RISKS IN THE PRODUCTION OF ENRICHED SUGAR

pages 44–48

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The object of research is the quality indicators of sugar enriched with derivatives of the processing of the fruits of wild plants (viburnum, mountain ash, sea buckthorn, black elder) and potential dangerous factors that may arise during its production. This study is aimed at the analysis and assessment of all risks that arise in the production of sugar enriched with derivatives of processing of wild raw materials. For the production of enriched sugar, pre-cleaned fruits were frozen at a temperature of -18 ± 2 °C, and after defrosting, they were partially dehydrated by the method of osmotic dehydration. For this, a 70 % sugar solution with a temperature of 50 ± 5 °C was used (hydromodule 1). The duration of osmotic dehydration was 1 hour. The derivative product formed as a result of osmotic dehydration of fruits (sugar solution) was used to enrich granulated sugar in the amount of 10 % by mass of sugar. After thorough mixing with the solution, the sugar was dried in a laboratory vacuum dryer and analyzed. Based on the principles of HACCP, a detailed description of the product and its use with a specific purpose has been developed. In particular, the description of all stages of production, from the initial materials to the processing and packaging processes, as well as the definition of all possible dangerous factors that can affect the safety and quality of products. The identification and assessment of all hazardous factors included the analysis of all possible threats to the safety and quality of products at each stage of production. To ensure the quality and safety of enriched sugar obtained from wild raw materials, an assessment of potential dangerous factors at all stages of production was carried out. A HACCP plan has been developed that allows effective management of critical control points and evaluation of the results of this management. This will allow potential manufacturers to produce safe and competitive products of high quality. The practical implementation of these proposals will allow bringing new products to the market – elderberry, sea buckthorn, rowan and viburnum sugar.

Keywords: viburnum sugar, elderberry sugar, sea buckthorn sugar, rowan sugar, product quality, product safety.

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DETERMINATION OF THE POSSIBILITIES OF USING THE UNIVERSAL LOW-TEMPERATURE ROTARY APPARATUS FOR THE PRODUCTION OF MEAT AND VEGETABLE PRODUCTS UNDER THE CONDITIONS OF PROVIDING UNIFORM HEAT SUPPLY

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The object of research is the process of frying a meat-vegetable product in the developed universal low-temperature rotary apparatus. The problem of ensuring the uniformity of the temperature field during low-temperature processing of meat and vegetable products is solved in the developed universal low-temperature rotary apparatus. The expected effect during the approbation of the apparatus is predicted under the condition of eliminating high-temperature intermediate coolants (hot air, etc.) due to the use of a film-like resistive electronic heater of the radiating type. The temperature field is established, which confirms the uniformity of the temperature effect on meat and vegetable products, and a slight deviation within the limits of autonomous exhaust fans is not critical and within the permissible error. Also, the introduction of Peltier elements into the design of the rotary apparatus will allow converting thermal energy

into a low-voltage supply voltage (3–6 W) and, already at 20 °C, ensure autonomous operation of fans. The obtained results in the form of practical implementation of the developed apparatus will allow to implement low-temperature processing of meat and vegetable products. This allows to maximally preserve the functional properties of meat raw materials and the physiological properties of vegetable semi-finished products with a high degree of readiness.

The practical implementation of the universal low-temperature rotary apparatus from the side of constructive implementation due to the use of functional containers makes it possible to obtain a wide range of assortment of meat products, both in the shell and without the shell. The elimination of high-temperature intermediate heat carriers (hot air, steam, etc.), their technical networks and generating apparatus ensures energy and metal-intensive resource savings. In addition, the introduction of multicomponent vegetable semi-finished products of a high degree of readiness (powders, pastes, etc.) into the recipes of meat products will lead to a partial replacement of the main recipe components and an increase in the functional properties of the finished products.

Keywords: low-temperature rotary apparatus, meat-vegetable product, polycomponent vegetable semi-finished products, temperature field.

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