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INNOVATIONS IN PUBLISHING, PRINTING AND MULTIMEDIA TECHNOLOGIES 2024

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TABLE OF CONTENTS

INNOVATIONS IN PUBLISHING, PRINTING AND MULTIMEDIA TECHNOLOGIES 2024
16th International scientific-practical conference
Pramones pr. 22, Conference Hall 1-57, Kaunas, Lithuania

PROGRAMME

24 April Wednesday	Moderators Danutė Lukaševičiūtė, *Kauno kolegija HEI, Lithuania* Virginijus Valčiukas, *Kauno kolegija HEI, Lithuania*	
9:00 - 10:00	REGISTRATION	
10:00 – 10:10	*dr. Tomas Makaveckas, Dean of the Faculty of Technologies, Kauno kolegija HEI, Lithuania*	
10:10 – 11:30	PLENARY SESSION	
10:10 – 11:30	Christian Greim, *Hochschule Mittweida/ University of Applied Sciences, Germany*	Better Representation of the Limits of RGB and CMYK Colour Spaces
10:30 – 10:50	Katarina Maričić, Nemanja Kašiković, Teodora Gvoka, Gordana Bošnjaković, *University of Novi Sad, Serbia*	The Influence of the Textile Substrate Colour on the Contrast of Thermochromic Prints
10:50 – 11:10	Uldis Cerbulis, *Heidelberg Baltic Finland OU, Latvia*	Shortage of Labor and Skills vs Smart Machines
11:10 – 11:30	Irena Bates, Ivana Plazonić, Maja Rudolf, Martin Gotlin, *University of Zagreb, Croatia*	Analysis of the Quality of Reproduction on a Graphic Product with More Positive Environmental Aspects (online)

11:10 – 13:10	COFFEE BREAK, Pramones pr. 22, Room 1-30	
11:50 – 12:10	SESSION 1 Moderators Danutė Lukaševičiūtė, Virginijus Valčiukas, Kauno kolegija HEI, Lithuania	
12:10 – 12:30	Ivelina Balabanova, Kristina Sidorova, Georgi Georgiev, *Technical University of Gabrovo, Bulgaria*	Security Monitoring Via Sound Analysis and Voice Identification with Artificial Intelligence
12:30 – 12:50	Lina Šarlauskienė, Samanta Dagytė, *Kauno kolegija HEI, Lithuania*	Criteria for Selecting Artificial Intelligence Tools
12:50 – 13:10	Skaidra Vaicekauskienė, *Kauno kolegija HEI, Lithuania*	Tool vs Creative Solutions: the AI in Publishing
12:50 – 13:10	Dominyka Vaičiūtė, *Kaunas University of Technology, Lithuania*	Study of the Operational Performances of Cardboard with Barrier Properties
13:10 – 14:00	LUNCH, Pramones pr. 22, Room 1-30	
14:00 – 16:20	SESSION 2, Renata Gudaitienė, Kauno kolegija HEI, Lithuania	
14:00 – 14:20	Anastasios E. Politis, *Chairman of the IC – International Circle of Educational Institutes of Graphic-Media Technology and Management, Vice President of HELGRAMED - the Hellenic Union of Graphic Arts and Media Technology Engineers, Greece*	DRUPA 2024 - Introduction to the Mega Event of the Printing Sector (online)

14:20 – 14:40	Sean Branagan, *Newhouse School at Syracuse University, United States of America*	Prescription for GenAI for Publishers, Faculty & Students (online)
14:40 – 15:00	Ivana Plazonić, Željka Barbarić-Mikočević, Magdalena Kralj, *University of Zagreb, Croatia*	Stability of the Cash Register Receipt Depending on the Thermal Paper Used (online)
15:00 – 15:20	Daiva Sajek, Virginijus Valčiukas, Gitana Ginevičienė, Vidas Vainoras, *Kauno kolegija HEI, Lithuania*	Study on the Quality of Reproduction of Graphical Linear Micro-Images Using Electrophotographic Printing
15:20 – 15:40	Stamatina Theohari, *University of West Attica, Greece;* Aida Michailidou, *University of South Athens, Greece*	Recent Progress in the Development of Paper Coatings for Food Packaging (online)
15:40 – 16:00	Dagnija Vanaga, *Institute of Polymer Materials, Riga Technical University, Latvia*	Replica of the 16th century Christopher Plantin's Printing Press
16:00 – 16:20	Svitlana Havenko, Marta Labetska, Mykola Havenko, Yaroslav Boychuk, Igor Karpa, *Ukrainian Academy of Printing, Ukraine*	A Systematic Approach to the Quality Assessment of Printed Products (online)
16:20 – 16:50	Discussions	

	POSTERS	
	Investigation of Mechanical Parameters of 3D Printed Acrylic Resin Samples Renata Gudaitiene, Audrius Čapskas, Vygintas Minkus, *Kauno kolegija HEI*, Andrius Darulis, *MB Labsamera, Lithuania*	
	Study Of The Quality Of Images Generated By Three-Dimensional Graphics Tools Renata Gudaitiene, Ingrida Vaitkutė, *Kauno kolegija HEI*	
19:00	GALA DINNER, Restaurant Bernelių užeiga, *M. Valančiaus str. 9, Kaunas*	
LECTURES FOR STUDENTS Thursday April 25, 2024		
10:00 – 11:30 Pramonės pr. 20, Room 3-43	Christian Greim, *Mittweida University, Germany*	What is an ICC Profile? Application, Structure, and Limits
11:45 – 13:30 Pramonės pr. 20, Room 3-43	Pedro Matos, *Portalegre Polytechnic, Portugal*	Labelling Design, Sustainability, Information and Citizenship
14:00 – 15:00 Pramonės pr. 20, Room 3-43	Stamatina Theohari, *University of West Attica, Greece*	Applications of Nanomaterials in Printing Inks and Coatings. Sustainability in Printing and Packaging Industry

BETTER REPRESENTATION OF THE LIMITS OF RGB AND CMYK COLOUR SPACES

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In our daily work in the graphic arts industry, we deal with the conversion of colour spaces. In particular, the conversion of additive colour systems into subtractive colour systems is technically extremely demanding. Among other things, the expansion of the colour spaces is limited. Why is this limitation necessary? Which limits make sense? Hardly any thought is given to this in everyday work. The limits are usually defined by the RGB colour space used. The colour spaces are commonly used according to their frequency of use in the graphics industry: Adobe RGB, sRGB and eci-RGB. These are usually displayed and compared in a CIE Yxy diagram. This type of diagram has the advantage that additive colour mixtures from two light sources actually all lie on a straight line. Unfortunately, a CIE Yxy diagram says little about how large a colour space is that is enclosed by a triangle, for example. It is therefore not really possible to compare how wide the respective colour spaces are and how many different colours can be represented from the humanly possible perception. A representation in other colour spaces with better equal spacing, such as CIE-Lab, is intended to illustrate better than before how good or bad the Adobe RGB, sRGB and eci-RGB colour spaces really are. The new visualisations were created using the Python library www.colour-science.org. The possibilities and limitations of this library will also be briefly explained. Finally, the diagrams obtained and presented are also related to the author's practical experience at the Mittweida University Printing Centre.

First, the limits of an offset colour space were determined only at the six corners of the primary colours and the first-order mixed colours in CIE-Lab. Then all mixtures of a solid colour with another colour were determined in 10% increments. This determined the limits of the most saturated colours in 10% increments. The results were processed with the Python library Colour-science.org. There, the data for offset printing was simply converted from CIE-Lab to CIE-Yxy. The data was then displayed in the CIE-Yxy diagram using Colour-science. In order to use the more equidis-

tant CIE-Luv colour space, the usual RGB colour spaces had to be divided into smaller steps.

The RGB colour spaces sRGB and Adobe RGB are usually used in colour management. The scope of the colour spaces is usually shown in the CIE Yxy colour space. Sometimes an offset colour space is also included in the diagrams to show the extent to which this is covered by the RGB colour spaces. This is physically correct for RGB colour spaces, but not very useful because the CIE Yxy colour space does not have uniform colour distances. The mixtures of offset colours never lie on a straight line in the CIE Yxy colour space. The study aims to achieve a more meaningful representation so that different colour spaces can be better compared.

The assessment of the use of RGB and possibly CMYK colour spaces should now be simpler and more meaningful.

Results: The result is diagrams not in CIE-Yxy, but CIE-Luv, which are more meaningful than the previous ones. In addition, program code has been created with which newer and future RGB colour spaces and diagram colour spaces can also be taken into account.

Keywords: sRGB, Adobe-RGB, PSOcoated_v3, Colourspace-Borders, CIE-Yxy.

THE INFLUENCE OF THE TEXTILE SUBSTRATE COLOR ON THE CONTRAST OF THERMOCHROMIC PRINTS

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Thermochromic inks have attracted much attention due to their application in various fields, including the textile industry. The application of these colors in sports clothing enables the monitoring of the athlete's physiological state through the possibility of changing the color of the material under the influence of skin temperature. Due to the printing of thermochromic inks on textile materials used for visual control, there is a need to analyze the contrast of the printed elements. Contrast plays a significant role in visually highlighting shapes and details, and also facilitates the recognition of printed parts and information on textile materials. This work aims to compare and analyze the contrast of thermochromic inks on different colors of the substrate of different types of materials, as well as to determine whether the color of the textile substrate on which the thermochromic ink is printed affects the color contrast when it is changed, i.e. its discoloration and return to its original state.

The study utilized magenta reversible thermochromic water-based leuco dye for printing samples on textile materials with different structures (polyester and a polyester-elastin blend) and colors (white, beige, gray, yellow, and purple). The colors were chosen to be bright and to provide a good contrast with the magenta color so that their combination attracts the attention of the viewer and can create a strong visual effect. Colorimetric analysis and contrast analysis were employed to evaluate the impact of substrate color on contrast values.

The results indicate a dependency of contrast values on the color of the substrate. Specifically, for textile material made of polyester, the white color of the substrate showed the highest contrast values. On the other hand, in the case of printed samples on a material made of a mixture of polyester and elastane, it can be concluded that the gray color of the substrate gives the highest contrast values.

The research highlights the importance of choosing colors and materials to achieve optimal results in the design and production of textile materials

with thermochromic inks. Understanding the relationship between substrate color and contrast values allows designers and manufacturers to make good decisions about choosing the colors of textile materials when printing with thermochromic inks because in this way a high level of aesthetics and functionality is achieved

Keywords: contrast, smart textiles, thermochromic inks.

ANALYSIS OF THE QUALITY OF REPRODUCTION ON A GRAPHIC PRODUCT WITH MORE POSITIVE ENVIRONMENTAL ASPECTS

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In recent years, there has been a growing trend worldwide to replace traditional wood fibers such as a raw material for paper production with non-wood fibers. By using alternative sources of cellulose fibers for paper production, such as cereal straw, deforestation is reduced, which is one of the positive environmental aspects of producing a graphic product with such a composition. Another positive environmental aspect of the graphic product made in this way is the elimination of the bleaching process in paper production, which has a positive effect on reducing chemical pollution. In the paper manufacturing process, the paper used for printing usually goes through a bleaching process that reduces the yellowish tone of the paper and increases light emission, brightness and contrast. However, looking at the matter from a different perspective, especially for small-scale production, the process of paper whitening can also be done differently, namely by coating the paper with a white pigment.

The aim of this research was to analyze whether it is possible to achieve the same reproduction quality with one or two layers of titanium dioxide on non-wood paper substrates as on commercially available standard paper type PS7 according to ISO 12647. The reproduction quality was tested by analyzing the reproduction of lines printed in different sizes using piezo inkjet technology.

Double-coated samples achieved 2.6 % better results than single-coated samples. The result closest to the reference sample PS7 was obtained with a paper containing 10 % wheat straw and coated with two layers of titanium dioxide.

The results obtained show that the proportion of wheat pulp does not lead to a deterioration in the quality of line reproduction in the prints, especially when the surface is coated with TiO_2.

Keywords: cereal straw, coating, paper, reproduction quality, titanium dioxide.

SECURITY MONITORING VIA SOUND ANALYSIS AND VOICE IDENTIFICATION WITH ARTIFICIAL INTELLIGENCE

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The paper presents the possibility of monitoring user access through authentication based on voice profiles using the means of Artificial Intelligence. A two-stage approach is proposed for sound analysis and voice recognition using Feed-Forward Neural Networks (FFNNs) and Cascade-Forward Neural Networks (CFNNs).

Seven test voice profiles were pre-processed to extract quantitative sound features. The procedure involves the registration of a set of sound parameters concerning three categories, respectively, for all audio and acoustic measurements in the entire sound spectrum, measurements up to and above 100 dBA. The neural architectures were trained with Scaled Gradient Descent and Levenberg Marquardt algorithms, using different output transfer functions in the output structural layers. In the initial phase of neural training, the entire sound spectrum of registered indicators was used, and high levels of classification accuracy around 90.0% were reached. Subsequently, steps were taken to reduce the informative features when searching for similar levels of accuracy in order to limit the necessary computational procedures in neural training, but maintain the threshold of successful user authentication. In the analysis of neural performance, in addition to accuracy, additional criteria were used, namely Mean-Squared Error (MSE) and Root Mean Squared Error (RMSE). About the achieved and analyzed results, a synthesis was conducted of a set of four informative features with the highest significance, respectively LAE (A-weighted, sound exposure level), Laeq (A-weighted, equivalent sound level), LAF (A-weighted, fast time-constant, sound level) and LAS (A-weighted, slow time constant response, sound level).

In the course of subsequent neural training processes, unsuitability was found when using the Log-sigmoid activation type with greatly underestimated accuracy readings and errors below 58.0% and above thresholds of 0.2300 and 0.4800. Positive performance indicators of voice recognition were achieved with Softmax and Hyperbolic tangent sigmoid activations in SCG and LM training procedures in levels of accuracy of 98.7 % and 96.1 %

at FFNN models. Successful correct recognition of the test voice profiles on access and security personalization with a quantitative equivalent of 100.0 % accuracy was achieved in the Linear transfer function for Cascade-Forward Neural Networks.

The proposed method and the synthesized neural models in the research can be used as units and modules in access control systems with biometric diagnostics and intelligent recognition of employees in company departments to electronically store classified information and physical access control.

Keywords: Security, Personal Authentication, Voice Profile, Sound Analysis, Neural Networks.

CRITERIA FOR SELECTING ARTIFICIAL INTELLIGENCE TOOLS

Lina Šarlauskienė, Samanta Dagytė
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Artificial Intelligence (AI) represents a transformative force across numerous sectors, from healthcare and finance to automotive and public services. The selection and deployment of AI tools are critical to leveraging this technology's potential while adhering to ethical standards, regulatory compliance, and ensuring societal benefit. The research was carried out using the analysis of scientific and other sources and the comparative analysis of selection criteria applied in other fields. The purpose of the article is to present general criteria for the selection of artificial intelligence, which would be compatible with EU regulatory documents on the use of AI. The research results showed that the list of basic and general selection criteria for artificial intelligence tools can be compiled according to the EU AI Act, which divides artificial intelligence systems into different risk levels, and 7 requirements of the Ethics Guidelines for Trusted Artificial Intelligence. In addition to the general criteria, the selection criteria of AI tools for specific fields of activity are also important. The results of the study can be useful for organizations and companies that are interested in selecting and using the right AI tools.

Keywords: artificial intelligence, selection criteria, EU regulations, publishing.

TOOL VS CREATIVE SOLUTIONS: THE AI IN PUBLISHING

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Kauno kolegija HEI

Today, the landscape of publishing, like all other digital technologies, is rapidly evolving. Artificial Intelligence is a comparatively new digital technology but it has spread very quickly into all areas of everyday life. New technologies bring new possibilities but also require new methodologies. Thus, the attempt to integrate Artificial Intelligence (AI) into the publishing process presents both - opportunities and challenges to the publishers' community and is very timely and relevant to meet the needs of society.

This presentation provides insights into leveraging AI's strengths while mitigating its limitations. Moreover, it seeks to foster a balanced approach to AI integration in publishing, ensuring that technological advancements enhance rather than overshadow the essence of creativity and editorial integrity. The analysis of the dynamic relationship between AI technologies and the creative processes inherent in publishing will succinctly explore the positive and negative aspects of AI integration to the publishing activities. By critically evaluating the benefits and limitations of AI technologies, we will seek to empower professionals to harness AI as a strategic asset while preserving the essence of creative expression and editorial integrity in publishing.

AI has emerged as a powerful tool in the publishing industry, offering capabilities ranging from content generation to personalized recommendations and audience analysis. Still because of that the extent to which AI serves as a mere tool versus a creative collaborator remains a subject of debate.

Keywords: Digital technologies, publishing, Artificial Intelligence, creative solutions.

STUDY OF THE OPERATIONAL PERFORMANCES OF CARDBOARD WITH BARRIER PROPERTIES

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This research aims to test and compare the cardboard with barrier properties and determine the one type with the best performance. As cardboard is not only used for food and pharmaceutical packaging, but can also be used as a means of displaying information, for example in Braille printing, it is important to determine which type of cardboard is the most resistant to wear and the least likely to deform under varying conditions. Also, it is important to compare and identify what kind of improvements could be made to existing materials to make the cardboard durable and eco-friendly.

Four types of cardboard with barrier properties were used for this study. For all the tests sample groups of different cardboards with different barrier properties were prepared and the specimens were kept and acclimatised under the same conditions before the tests. The specific software and devices were used to determine the final results. Wetting test, Braille measuring test and bending fatigue tests were conducted to determine any significant differences between different types of MMK cardboard. These types of tests were chosen to compare the cardboard types as they are close to using packages under real conditions.

The results of this study have shown that there are no significant changes, which could make packages unusable, but there were some differences in performance, which mainly could have been caused by different barrier properties of each type of cardboard. As a result of this, one type has shown better performance in both Braille measuring and wetting tests. Although barrier properties make the cardboard less absorbent, the different sides show significant differences in wetting, which could be improved in the future.

The study was carried out to check the operational performances of four different types of cardboard and their behaviour caused by changed surroundings. The results have shown that all the types are proper for use but have to be kept away from direct wetting or wearing and tearing. This research has led to new directions and ideas on how to improve cardboard and make it an even more robust but environmentally friendly material.

Keywords: Barrier properties, cardboard packages, cardboard improvements, MMK cardboard.

STABILITY OF THE CASH REGISTER RECEIPT DEPENDING ON THE THERMAL PAPER USED

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The consumption of thermal paper has globally increased due to a wide variety of commercial applications including Point-Of-Sale (POS) receipts, luggage tags, faxes, and labels. This type of paper is specially used for cash register printing paper and, therefore its quality directly affects the quality of printing, stability and resistance during storage of receipt printouts. Often such prints end up in the trash can very quickly after a purchase, but sometimes there is an interest in saving them after buying products that have a guaranteed period of two years or more.

Therefore, in this study, the comparison of two different cash register thermal papers (white and blue) was made based on paper characteristics, while the stability on the printed receipt was determined based on the change in colorimetric values after their exposure to a certain treatment. Three types of stability analysis were done which include sample exposure to light, pressure and water. Since colorimetric changes in the color of cash register thermal paper and receipt are a visible sign of their quality degradation, the influence of contact with water, pressure and light was observed through ΔE*00.

Under the influence of water and light cash register receipt on white thermal paper faded but stayed permanent on blue one. Also, the receipt printed on blue thermal paper was more stable to rub and there was less color transfer.

It has been proven that blue cash register thermal paper is more stable than white one, and so are the receipts printed on that type of thermal paper.

Keywords: cash register receipt, thermal paper, stability.

STUDY ON THE QUALITY OF REPRODUCTION OF GRAPHICAL LINEAR MICRO-IMAGES USING ELECTROPHOTOGRAPHIC PRINTING

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Today's market of visual graphic communication includes advertising, publishing, and packaging products printed on various materials. Many products are printed using conventional printing technologies such as offset printing or flexography, in addition to digital ones like Electrophotography and Ink-Jet. The images often contain extremely fine graphic details, such as micro-lines or micro-text elements, which are part of various identification, security marking, codes, etc. The quality of printing of these micro-images, the geometric definition, accuracy and legibility of their elements, including identification by automated techniques, depend on many parameters: the resolution (dpi) of the digital press, the properties of the printing materials, the composition and physical characteristics of the ink, etc. Currently, various digital print quality control wedges are used to ensure the reproduction accuracy of graphic micro-images, yet they lack information to allow the accuracy of the reproduction of a wide range of micro-images to be monitored conveniently under production conditions. The study aims to develop a universal scale to control and pre-model the reproduction quality of digitally printed linear micro-images over a wider range.

To model the reproduction quality and geometric accuracy of visual linear micro-images when printed by various digital printing methods on different materials, an original tool, the variable image information scale, was developed in Adobe Illustrator. Fragments of this scale are shown in the figure below.

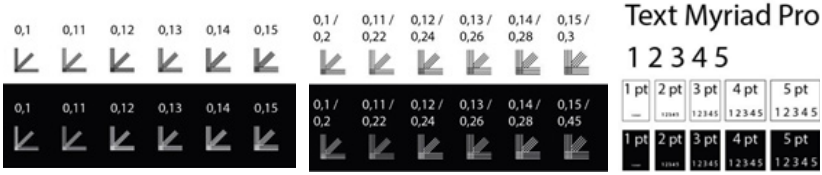

Fig. Fragments of the control image information scale: 100-150 µm positive and negative micro-lines; 1-5 pt micro-text

The scale shows the micro-lines arranged individually and in groups ranging from 10 μm to 150 μm in width, varying in 10-micrometre intervals. The micro-lines are aligned individually with double-width spacing and in groups with equal-width spacing; they are aligned parallel, perpendicular and at an angle of 45˚ to the printing direction. The micro-lines and micro-fonts are arranged in the positive and negative fields of the scale. The print tests were printed on electrophotographic presses 1 and 2 using dry ink (toner) at 1200 dpi and 2400 dpi resolution on different paper. The width of the micro-lines on the print was measured using a microscope.

Measurements of the reproduction accuracy of monochrome micro-line images showed that, when using different electrophotographic digital printing systems, the accuracy of micro-line reproduction depends not only on the printing system, its resolution and the characteristics of the paper, but also on the direction of the positioning of the micro-lines on the printing sheet. The results of measurements indicate that the reproduction accuracy of fine micro-lines up to 100 μm is higher when these lines are positioned in the printing direction; micro-lines positioned at an angle of 45˚ have the lowest reproduction accuracy.

The results suggest the accuracy of the reproduction of graphic image micro-elements for different electrophotographic printing systems using dry ink (toner). Also, it is possible to compare the capability of printing systems to reproduce linear micro-images or micro-type on visual graphic communication products of any size and geometric orientation, to select optimal systems for printing specific products, and to model the layout of micro-images on products at the design stage, by assessing the orientation of the micro-images on the printed sheet.

Keywords: Electrophotography, digital printing, control wedge, micro-lines.

RECENT PROGRESS IN THE DEVELOPMENT OF PAPER COATINGS FOR FOOD PACKAGING

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Many types of coatings have been developed to meet the demanding needs and properties of paper-based packaging, which is the most widely used sustainable category of food packaging. The purpose of this paper is to list and classify special sustainable coatings, such as bio-based coatings and coatings based on nanomaterials (NPs) that provide barrier, optical, mechanical, anti-microbial and other properties as well as additional functions to the final product for food paper packaging.

The study is an overview of the previously published works on trends and challenges in the development of healthy and eco-friendly sustainable food paper packaging applications, which are green alternatives for conventional coatings.

Paper/paperboard packaging is naturally sensitive to microbial attack due to the poor barrier properties (i.e. hydrophilicity, porosity, low grease resistance, high absorptivity to gases and water vapours), because of their structure made from cellulose fibres. Thus, paper packages must be properly coated in order to withstand and keep the food safe, preventing temperature, humidity and other factors of the surroundings that affect the composition of packaged food. However, the current market is based on the application of commonly used coatings, which are typically made from fossil-oil or synthetic polymers, waxes and /or fluor-derivatives that improve surface hydrophobicity and barrier properties. Nowadays, the use of these materials is limited because of problems arising from fossil-oil resources, poor recyclability, and environmental issues. Therefore, these coatings must be replaced by new materials, with high biodegradability, recyclability and compostability features. Recent studies are focused on biopolymers including polysaccharides as chitosan, starch, etc., proteins as whey, wheat gluten, and zein, polyesters as polylactic acid (PLA), polycaprolactone (PCL), and polyhydroxyalkanoates (PHAs) that are investigated to formulate coatings with barrier properties for food packaging paper. Petroleum-based polymers are commonly used in paper coating. Due to the good affinity with the substrate, they create suitable barriers to gases and aroma and increase the me-

chanical strength of the paper packaging. Moreover, biopolymer products have been developed as counterparts to smoothly replace petroleum-based polymers. They can be made from natural raw materials and sources, such as vegetal and marine biomass, this way they can be biodegradable, and non-toxic. Additionally, they act as a basis for the incorporation of additives with specific functions for coated paper (i.e. active-antimicrobial properties). The methods of chemical modification and combination as well as the processing and production of these new coatings for paper packaging are still under investigation. The addition of certain nanoparticles (NPs) such as metals and oxides in biopolymers and green coatings could be advantageous to add value and enhance processing, performance and functionality of food paper packaging.

The application of coatings on paper-based food packaging is extensively investigated to replace petrochemical derivatives by choosing environmentally friendly alternatives that come from natural and renewable resources. These options determine the ultimate recyclability, biodegradability and even compostability of the final product. The incorporation of certain nanomaterials in the coatings promises to provide a wide range of enhanced properties and improve barrier characteristics of the paper-based food packaging.

Keywords: Barrier properties, Bio-based coatings, Nanomaterials, Paper food packaging, Sustainability.

A SYSTEMATIC APPROACH TO THE QUALITY ASSESSMENT OF PRINTED PRODUCTS

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Quality standards for the technological processes of the production of finished products are used in all countries worldwide. There has been a significant increase in consumer demand for ISO 9001 quality system certificates from manufacturing companies. It should be noted that international and national standards use different approaches to the standardisation of processes and products, and the content of project management. To meet the demands of consumers, which are constantly growing, quality management should be carried out based on a set of scientifically based principles, which can be divided into system-wide and special. The problem is relevant for modern Ukrainian enterprises, where, on one hand they need serious changes in the organisational structure, corporate culture, style and methods of project management; and on the other hand, compliance with the ratio of responsibility for quality between the management system and performers.

Evaluation of the quality of printed products at the current stage requires the application of the principles of a systematic approach, based on the principles of which it is possible to build a coherent, logically completed methodological system of quality indicators of a specific type of product. This will also make it possible to justify the problem of choosing certain methods and will give a normative and regulatory character to those indicators that are not reflected in the standards but are important for the practical use of products.

To create one or another model of the system, it is first necessary to carry out its verbal and informational description and tuple recording. The components of a verbal informational description usually reflect a description of the external environment, and the system's connections with it; identification of the relationship between factors, characteristics of the variability of factors; elementary composition of the system, and its parts; description of connections between elements of the system and subsystems; operation of the system, i.e. description of the process of functioning and development of the system. The tuple record of the system model of the quality assessment takes

into account the classification characteristics of products, the set of “inputs” and “outputs” of the system; a set of variable parameters and processes.

The goals of quality management at each stage of the technological process for each specific type of printed product can be individual. To cover the management of all stages of the life cycle of media or packaging products within the subsystems of the quality system, it is necessary to perform a full set of special (specific) quality management functions. The matrix method or elements of the ISO 9000 series system can be used to form these functions.

Keywords: systematic approach, quality, printed products, standard.

INVESTIGATION OF MECHANICAL PARAMETERS OF 3D PRINTED ACRYLIC RESIN SAMPLES

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Three-dimensional graphics and printing are one of the fastest developing areas of media technology. These technologies are applied in medicine, construction industry, creating advertisements, project visualizations, packaging, and industrial engineering products. Using three-dimensional modeling and printing, it is possible to create products ranging in size from small to large which are assembled from individual parts. Resins with different properties can be applied to household products, packaging, jewelry manufacturing, robotics or even the construction sector. In order to create various products, it is important to know the technical characteristics of materials (plasticity, resistance to temperature, light, mechanical properties). Taking into account the areas of applicability of the resin, the main goal of this work was to investigate the strength properties of the XVN-50 resin (maximum force, stress, elongation), depending on the exposure wavelength for the polymeric samples.

In this work, a new AmeraLabs XVN-50 resin was used for research. The specimens were modeled using Autodesk Fusion 360 software. After printing, the samples were additionally polymerized using different UV light. For determining the strength properties, the tension measurement stand was chosen: the universal 10 kN power testing machine Tinius Olsen H10KT with a 500 N force measurement sensor. Tensile measurements were made according to the ISO 527-5A standard (tensile time 5 min, distance between grips 25 mm).

During this work, using Autodesk Fusion 360 program, the samples were modeled and prepared for printing using CHITUBOX program according to the standard. After 3D printing, the samples were additionally polymerized using different UV wavelengths. The strength properties of the samples were studied mechanically by stretching the samples and recording their breaking force, stress and elongation parameters.

The research showed that the samples after printing were very plastic and had a rather pronounced spread of stress parameters. After exposure to UV radiation, the samples were more stable and tended to sustain higher loads depending on the wavelength of the UV light.

Keywords: three-dimensional modeling, 3D printing, UV excitation, resin, mechanical parameters.

STUDY OF THE QUALITY OF IMAGES GENERATED BY THREE-DIMENSIONAL GRAPHICS TOOLS

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With the development of information and media technologies, more and more attention is paid to the side of visual expression. In this case, three-dimensional (3D) technologies serve very successfully, with the possibility to create very realistic images that would be difficult to distinguish from real photographs. In order to obtain the realism of the image, it is important to choose the visualization engine and the necessary textures correctly, considering the nature of the work. The choice of the visualization engine and its material library can have a significant impact on the quality of the final image. The main goal of this work was to investigate the quality of generated images of 3D visualizations created using different visualization engines, depending on the selected textures and lighting parameters.

For this work the practical-experimental research method using information technology was applied. The „Autodesk 3DsMax“ software was used for object modelling and three-dimensional images visualization, using three plug-ins (visualization engines or renderers) such as “Arnold”, “Chaos Corona” and “V-ray”, within this 3D program. The quality of the images was determined after rendering process.

In order to evaluate the quality of the images, three-dimensional objects were modelled. The textures that caused the most trouble and were the most difficult to render were assigned to them. To get a realistic picture, common lighting settings for color temperature and light intensity were used.

The results of the study showed that the most visible difference was between the objects colors of glass and metal. After comparing the samples using different colors temperatures, it was observed that the samples generated by Corona were more yellow and darker at the same light intensity. At low temperatures (at 2000 K), V-ray showed the best result. The low intensity of light use gave higher unwanted graininess of the images.

Keywords: three-dimensional graphic, 3D modelling, rendering, visualization, image quality.

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