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STUDIES ON CHILD RESISTANT PACKAGING (CRP) AND CLOSURES

PACKAGING INDUSTRY'S MONTHLY

Opakowanie

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FIRST-HAND INFORMATION

FROM THE PACKAGING INDUSTRY

Opakowanie.pl

Dear Readers!

All packaging industry professionals are invited to the 14th edition of the Safe Packaging Conference. The event will be held on November 19-20 at the DoubleTree by Hilton hotel in Łódź.

This year you can count on a very interesting program, which will cover a number of aspects of the production of ecological, safe, economical and innovative packaging. The material side of the process will be presented by ACTEGA with a presentation on ACTGreen barrier coatings, a sustainable alternative to multilayer substrates; hubergroup will talk about the challenges and transformation in a dynamically changing industry; and Metsä Board will present opportunities to reduce environmental impact with closed-loop packaging solutions. Sustainable solutions for flexo printing – photopolymer plates and technologies from MacDermid Graphics Solution will be discussed by its Polish distributor, Wolff Poligrafia.

Zero fault packaging production technology will be presented by BOBST, and GRAW, distributor of the Edale brand in our market, will talk about the possibility of producing from sheet to box in 15 minutes in a single pass. The potential for optimizing processing lines for safe packaging production will be discussed by Heidelberg.

Production of safe packaging is not possible without advanced automation at the level of not only physical processes, but also software. The highest level of optimization for complex production schedules will therefore be brought closer by eProductivity Software.

We will close the loop with a discussion with ML Polyolefins, during which we will present the stirring topic of using recyclates in packaging. The icing on the cake will be the presentation of the situation and prospects of the Polish packaging industry – an annual report prepared by Bank Pekao analysts.

On the second day of the event, we will visit the Łódż Institute of Technology, which, together with the Packaging Center located in Warsaw, provides research on packaging and packaging materials, biopolymers, biomaterials (including biodegradable, compostable), active, intelligent, and with recycled raw materials. We will learn about the research center's offerings, including training, development of new material combinations, optimization of new plastics and laminates in the production of flexible packaging, consulting on packaging technology, recycling technology and recovery of packaging materials and packaging. An important aspect of ŁIT's activities is the area of packaging manufacturing technologies and technologies for printing biodegradable materials with ecological inks.

The event will provide many opportunities for networking, exchanging experiences and making new contacts, so it is y worth ensuring your participation in the 14th edition of the Safe Packaging Conference.

Registration has already started at www.konferencja.opakowanie.pl!

Stefan Jakucewicz, D.Sc, Ph.D, Prof. emeritus Warsaw University of Technology. A graduate of Łódź University of Technology in the field of cellulose and paper technology, as well as Warsaw University of Technology in the field of printing. From 1974 he was a researcher at TU Warsaw. Since September 2018 he has been a pensioner. The editor of the sections in the periodicals: Opakowania (Packaging) and Przegląd Papierniczy (Paper Review). Research interests: printing materials science, paper technology and printing techniques of various substrates, with particular emphasis on plastics and the production of printed packaging, production of banknotes and postage stamps (security prints), certification of new base materials for both classic and digital printing techniques. Author or co-author of over 300 scientific articles published in Ukrainian, Slovak and German national journals, and 70 scientific and scientific-technical books published in Polish, German, Slovak and Ukrainian.

Drodzy Czytelnicy!

Wszystkich profesjonalistów branży opakowaniowej zapraszamy na 14. edycję konferencji Bezpieczne Opakowanie. Wydarzenia odbędzie się w dn. 19-20 listopada br. w hotelu DoubleTree by Hilton w Łodzi.

W tym roku możecie Państwo liczyć na bardzo ciekawy program merytoryczny, który obejmie szereg aspektów produkcji ekologicznych, bezpiecznych, ekonomicznych i innowacyjnych opakowań. Materiałową stronę procesu przedstawią firmy ACTEGA z prezentacją na temat powłok barierowych ACTGreen, stanowiących zrównoważoną alternatywę dla wielowarstwowych podłoży; hubergroup opowie o wyzwaniach i transformacji w dynamicznie zmieniającej się branży, zaś Metsä Board przybliży możliwości zmniejszenia wpływu na środowisko dzięki rozwiązaniom w zakresie opakowań o obiegu zamkniętym. Zrównoważone rozwiązania dla druku fleksograficznego – płyty fotopolimerowe i technologie firmy MacDermid Graphics Solution omówi jej polski dystrybutor, firma Wolff Poligrafia.

Technologię produkcji opakowań bez błędów zaprezentuje firma BOBST, a o możliwości produkcji od arkusza do pudełka w 15 min. w jednym przebiegu opowie firma GRAW, dystrybutor marki Edale na naszym rynku. Potencjał optymalizacji linii technologicznych zapewniających bezpieczeństwo produkcji opakowań omówi firma Heidelberg.

Produkcja bezpiecznych opakowań nie jest możliwa bez zaawansowanej automatyzacji na poziomie nie tylko procesów fizycznych, ale także oprogramowania. Najwyższy poziom optymalizacji dla złożonych harmonogramów produkcji przybliży zatem firma eProductivity Software.

Obieg zamkniemy dyskusją z firmą ML Polyolefins, w czasie której przedstawimy budzący wiele emocji temat wykorzystania recyklatów w opakowaniach. Wisienką na torcie będzie prezentacja sytuacji i perspektyw polskiej branży opakowaniowej – dorocznego raportu przygotowywanego przez analityków Banku Pekao.

Drugiego dnia wydarzenia odwiedzimy Łódzki Instytut Technologiczny, który wraz z warszawskim Centrum Opakowań realizuje usługi w zakresie badania opakowań i materiałów opakowaniowych, biopolimerów, biomateriałów (w tym biodegradowalnych, kompostowalnych), aktywnych, inteligentnych, a także z udziałem surowców z recyklingu. Zapoznamy się z ofertą ośrodka badawczego, obejmującą szkolenia, opracowywanie nowych połączeń materiałowych, optymalizację nowych tworzyw i laminatów w produkcji opakowań giętkich, doradztwo z zakresie technologii pakowania, technologii recyklingu i odzysku materiałów opakowaniowych i opakowań. Istotnym aspektem działań ŁIT jest obszar dotyczący technologii wytwarzania opakowań oraz technologii druku farbami ekologicznymi materiałów przeznaczonych do biodegradacji.

Wydarzenie stworzy wiele możliwości do networkingu, wymiany doświadczeń i nawiązywania nowych kontaktów, już dziś warto więc zapewnić sobie udział w 14. edycji konferencji Bezpieczne Opakowanie.
Rejestracja już ruszyła na www.konferencja.opakowanie.pl!

Dr hab. inż. Stefan Jakucewicz, em. prof. PW. Absolwent Politechniki Łódzkiej w zakresie technologii celulozy i papieru oraz Politechniki Warszawskiej w zakresie poligrafii. Od 1974 roku pracownik naukowo-dydaktyczny Politechniki Warszawskiej, od września 2018 emeryt. Redaktor działowy w czasopismach „Opakowanie" i „Przegląd Papierniczy". Zainteresowania naukowe: materiałoznawstwo poligraficzne, technologia papieru oraz techniki drukowania różnych podłoży ze szczególnym uwzględnieniem tworzyw sztucznych i produkcji opakowań drukowanych, produkcji banknotów oraz znaczków pocztowych (druki zabezpieczone), atestacja nowych materiałów podłożowych przeznaczonych tak do klasycznych, jak i cyfrowych technik drukowania. Autor lub współautor ponad 300 artykułów naukowych opublikowanych w czasopismach krajowych, ukraińskich, słowackich i niemieckich oraz 70 książek naukowych i naukowo- technicznych wydanych w językach polskim, niemieckim, słowackim i ukraińskim.

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THE RESEARCH NETWORK ŁUKASIEWICZ – ŁÓDŹ INSTITUTE OF TECHNOLOGY
LABORATORY OF MATERIALS AND CONSUMER PACKAGING TESTING

STUDIES ON THE PACKAGING PROTECTED AGAINST THE UNDESIRED OPENING BY A CHILD (CRP PACKAGING AND CLOSURES)

BADANIE OPAKOWAŃ ZABEZPIECZONYCH PRZED NIEPOŻĄDANYM OTWARCIEM PRZEZ DZIECKO (OPAKOWANIA CRP I ZAMKNIĘCIA)

ABSTRACT: To protect the children against the incidents connected with swallowing of dangerous substances and pharmaceuticals, the packaging intended for medicines and dangerous substances should be so designed as to make their opening by children impossible. The studies of CRP (Child Resistant Packaging) packaging are carried out in accordance with three standards, depending on the destination of the packaging.
Key words: children, CRP packaging, designing of packaging, dangerous substances

STRESZCZENIE: W celu ochrony dzieci przed wypadkami związanymi z połknięciem substancji niebezpiecznych, farmaceutyków opakowania przeznaczone na leki oraz substancje niebezpieczne powinny być tak projektowane, aby uniemożliwiać ich otwarcie przez dzieci. Badania opakowań Child Resistant Packaging (CRP) wykonywane są zgodnie z trzema normami, w zależności od przeznaczenia opakowania.
Słowa kluczowe: dzieci, opakowania CRP, projektowanie opakowań, substancje niebezpieczne

The basis function of packaging is to preserve the quality of the products during their storage, transport, delivery, sale and application. During the design work, the type of the packed product, its properties and, also, individual legislation requirements, are significant. The design guidelines concern the structure of ready packaging as well as raw materials from which the packaging is manufactured. The packaging equipped with the closure making opening for the children difficult and with tactile warning about the danger are especially important group of packaging. The civilisation progress and development of industry which offers new chemical products have caused that the availability of the products, potentially dangerous to man, is increasing. The small children are especially endangered to acute accidental poisoning, what is connected with the natural need of familiarization with the surrounding world, using sense of taste, with the simultaneous lack of awareness of the possible threats. The group of the products, being the greatest danger for the children includes pharmaceuticals, cosmetics and domestic cleaning agents [1, 2]. The packaging protected against undesired opening by the children must be so designed as to minimize the risk of opening of packaging, containing the products that create a potential hazard. The packaging safe for the children cannot look as the packaging for food, cannot possess shape or graphic decoration which might attract the attention of the children.

TAB.1. CATEGORIES OF SUBSTANCES AND MIXTURES WHICH REQUIRE CRP PACKAGING

Category (class) of hazard	Closures making opening by the children difficult
Acute toxicity (categories 1-3)	x
Specific Target Organ Toxicity (STOT) single exposure (category 1)	x
Specific Target Organ Toxicity (STOT) repeated exposure (category 1)	x
Corrosive effects to the skin (categories 1A, 1B, 1C)	x
Hazard caused by aspiration (category 1) (Except for substances or mixtures in a form of aerosol or in hermetic container with atomizer, under the condition that they are not classified into another hazard category, subjected to the rules in respect of CRF or TWD)	x

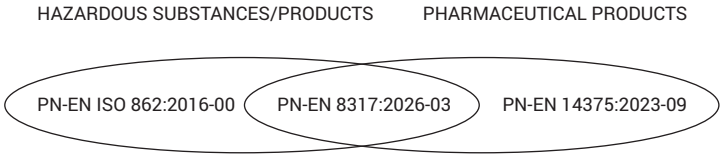
The Regulation (EC) No 1272/2008 of the European Parliament and of the Council of 16 December 2008 on classification, labelling and packaging of substances and mixtures, amending and repealing Directives 67/548/EEC and 1999/45/EC and Regulation (EC) No 1907/2006 specifies which substances and mixtures must be packed in a way protected from the children [3]. Packaging of CRP type (Child Resistant Packaging), as containing the hazardous substance or mixture cannot be designed in a way which creates the probability of attracting the attention of the children, induces their curiosity, or misleads the consumers.

List of hazardous substances and hazardous mixtures, the packaging of which are equipped with the closures making the opening by the children difficult is given in Tables 1 and 2.

In the case of pharmaceutical product packaging in Poland, there is no legal regulation, commanding the application of specified types of packaging, being protected against undesired opening by a child.

Testing of RCP packaging is conducted according to the following standards [4 – 6]:

– PN-EN 862:2016-09 Packaging-Child-resistant packaging-Requirements and testing procedures for non-reclosable packages for non-pharmaceutical products
– PN-EN ISO 8317:2016-03 Child-resistant packaging-Requirements and testing procedures for reclosable packages.
– PN-EN 14375:2023-09 Child-resistant non-reclosable packaging for pharmaceutical products-Requirements and testing



The tests – in conformity with the standards – are employed in relation to the packaging of pharmaceutical and chemical products such as detergents, disinfectants, washing pellets, e-cigarettes and plant protection agents, containing the substances listed in the Regulation [3].

The test packaging must be filled with the appropriate safe replacer e.g. water, peas etc.

The tests of the packaging protected against the undesired opening by a child have two-part procedure of testing. The first one includes the tests in a group of the children at the age of 42 – 51 months of life. In the mentioned group, we have to consider the proportional classification according to age and

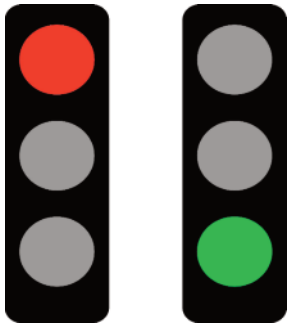
TAB.2. SUBSTANCES WHICH REQUIRE APPLICATION OF CRP PACKAGING

Identification of substance	Concentration limit	Closure making opening by the children difficult
Methanol (No CAS 67-56-1)	3%	x
Dichloromethane (No CAS 75-09-2)	1%	x

gender and, also, representativeness in respect of social, ethnic and cultural origin. During the test, the child should not test more than one package even in the case of their different construction. The test is carried out in the site which is well known to the child (e.g. at the kindergarten), far from the children who do not participate in a given test and far from the external factors, which disperse the attention of the child, and at the presence of a person who supervises the test.

In the second part of the mentioned procedure, the test is carried out with the group consisting of 100 adult persons (30 men and 70 women) at the age of 50-70 years. The test may be attended by the persons not related to designing, production and application of the packaging protected against the undesirable opening by the children. The test with the participation of the adult persons may be conducted at any place and any time.

The packaging is considered as protected against the undesirable opening by the children if at least 85% of the children from the research group were not able to gain an access to the packaging during 5 minutes. The result of the test with the participation of the adults is considered as positive when at least 90% of the adult persons open the packaging during 1 minute.



CHILDREN **ADULTS**

The packaging recognised as protected against undesired opening by the children cannot be opened by a child whereas a group of the adults must have an easy access to the packaging.

LITERATURE

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3. Rozporządzenie Parlamentu Europejskiego i Rady (WE) nr 1272/2008 z dnia 16 grudnia 2008 r. w sprawie klasyfikacji, oznakowania i pakowania substancji i mieszanin, zmieniające i uchylające dyrektywy 67/548/EWG i 1999/45/WE oraz zmieniające rozporządzenie (WE) nr 1907/2006 (In English: The Regulation (EC) No 1272/2008 of the European Parliament and of the Council of 16 December 2008 on classification, labelling and packaging of substances and mixtures, amending and repealing Directives 67/548/EEC and 1999/45/EC and amending the Regulation (EC) No 1907/2006)
4. PN-EN 862:2016-09 Opakowania – Opakowania zabezpieczone przed otwarciem przez dziecko-Wymagania i metody badań opakowań nieprzystosowanych do wielokrotnego zamknięcia na produkty inne niż farmaceutycze. (In English: Packaging-Child-resistant packaging-Requirements and testing procedures for non-reclosable packages for non-pharmaceutical products
5. PN-EN ISO 8317:2016-03 Opakowania zabezpieczone przed otwarciem przez dziecko – Wymagania i metody badań opakowań przystosowanych do wielokrotnego zamykania. (In English: Child-resistant packaging-Requirements and testing procedures for reclosable packages.)
6. PN-EN ISO 14375:2023-09 Opakowanie do produktów farmaceutycznych, nieprzystosowane do wielokrotnego zamykania, zabezpieczone przed otwarciem przez dzieci. Wymagania i badania (In English: Child-resistant non-reclosable packaging for pharmaceutical products-Requirements and testing).

Laboratory of Materials and Consumer Packaging Testing as acting under the frames of Łukasiewicz research Network-Łódź Institute of Technology conducts the tests of packaging protected against undesired opening by a child in compliance with the standards: PN-EN ISO 862:2016-00, PN-EN 8317:2026-03 and PN-EN 14375:2023-09. The tests are covered with the accreditation of Polish Centre for Accreditation No AB 185.

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GLOBAL MIGRATION ANALYSIS OF REUSABLE FOOD CONTACT PACKAGING EXPOSED TO VARYING MICROWAVE POWER LEVELS AND DURATIONS

ANALIZA GLOBALNEJ MIGRACJI SUBSTANCJI Z OPAKOWAŃ WIELOKROTNEGO UŻYTKU DO ŻYWNOŚCI PODDANEJ RÓŻNYM POZIOMOM MOCY I CZASU DZIAŁANIA MIKROFAL

ABSTRACT: This paper focuses on the study of specific cases of substance migration from plastic packaging into food, aiming to better understand this phenomenon and assess its potential impact on food quality and safety. The samples consisted of 5 food containers obtained from publicly accessible retail chains. In the case of reusable packaging, in accordance with Commission Regulation (EU) No 10/2011 on plastic materials and articles intended to come into contact with food, and Commission Regulation (EU) 2020/1245 amending and correcting Regulation 10/2011, the overall migration test for reusable products and materials is performed three times on the same sample, each time using
a different dose of a food simulant liquid. All containers were made of polypropylene (PP / 5) according to the markings on the bottom of the packaging, and were indicated by the manufacturers as suitable for microwave heating and freezing. Therefore, the tests also included trials with the use of microwaves. Consequently, tests were prepared for the first part of the study to account for the impact of microwave treatment on the overall migration of the examined containers into food simulant liquids, and for the second part of the study, in which the overall migration was conducted three times on the same packaging sample.
Key words: global migration, microwaves, food safety, polypropylene

STRESZCZENIE: Niniejsza praca koncentruje się na badaniu specyficznych przypadków migracji substancji z opakowań z tworzyw sztucznych do żywności, co ma na celu lepsze zrozumienie tego zjawiska oraz ocenę jego potencjalnego wpływu na jakość i bezpieczeństwo żywności. Próbki stanowiły 5 pojemników na żywność pozyskanych z ogólnodostępnych sieci handlowych.
W przypadku opakowań wielokrotnego użytku zgodnie z Rozporządzeniem Komisji (UE) nr 10/2011 w sprawie materiałów i wyrobów z tworzyw sztucznych przeznaczonych do kontaktu z żywnością oraz Rozporządzeniem Komisji (UE) 2020/1245 w sprawie zmiany i sprostowania Rozporządzenia 10/2011 badanie migracji globalnej wyrobów i materiałów wielokrotnego użytku przeprowadza się trzy razy na tej samej próbce, za każdym razem używając innej dawki płynu modelowego imitującego żywność. Wszystkie pojemnik zgodnie z oznaczeniami na dnie opakowania wykonane były
polipropylenu (PP/5) oraz z sugerowaną przez producentów możliwością stosowania ich do podgrzewania mikrofalowego oraz mrożenia. Z tego względu w badaniach zdecydowano się również uwzględnić próby z wykorzystaniem mikrofal. W związku z tym zostały przygotowane próby na
I część badań uwzględniając wpływ obróbki mikrofalowej na migrację globalną badanych opakowań do płynów imitujących żywność oraz na II część badań, w której przeprowadzono migrację globalną trzy razy na tej samej próbie opakowania.
Słowa kluczowe: opakowania, opakowania wielomateriałowe, odpady opakowaniowe

INTRODUCTION

Global production of plastics is constantly growing. During 50 years, production of plastics increased from 15 million tonnes in 1964 to 311 million tonnes in 2014 [4]. During the recent years the mentioned increase has remained rather slow; all over the world, production increased by 12 million tonnes in the years 2009-2014 and in Europe – from 55 million t in 2009 to 59 million tonnes in 2014[5]. Production of Finnish plastics constitutes a percent of the European production, that is, about 600 000 tonnes [6].

The need of feeling safe, being one of the fundamental human needs, should be satisfied also via packaging. According to the definition suggested by Lisińska-Kusnierz (2011 [11], safe packaging is "the packaging which under the typical or other, foreseeable conditions of utilization, does not create a risk for the consumer, or represents the minimum risk which may be conciliated with its standard utilization. The mentioned packaging considers a high level of requirements concerning protection of human health and life".

Food packaging is one of the most important processes in food industry, which helps in maintaining the quality of food products during their storage, transport and distribution [18]. It occurs so, first of all, with the aim to protect food products from the external factors such as biological and chemical damage and mechanical damages, to store food, and keep it in the packaged state via preventing the deterioration of the quality and attracting the consumers as well as supplying information on the product and its nutritive values. For the years, the ancient people consumed fresh food which they could gather from their natural environment without the storage of food products [22, 1].

In 2018, the European Commission adopted the European strategy for a closed economy, with the aim to support, strengthen and accelerate the application of the measures aiming at reduction of the amount of the plastic waste. One of the key elements of the mentioned plan is "the improvement of economics and quality of plastics recycling" [5]. Moreover, as being considered as important goal, it was mentioned that up to 2030 all plastic packaging introduced to the EU market must be reused or subjected to recycling in a profitable way [2]. When taking into consideration that recycling in a circular system is also covered with the discussed program, i.e. recycling of food packaging into new food packaging materials, the question arises: 1) what will be the impact of the EU strategies concerning the plastics in a circular economy on food safety and 2) whether it is possible to identify and quantify all risk connected with it for food safety [23]. Due to the discussed requiring EU policy, the packaging industry stays before the serious challenge i.e. recycling of packaging polymers. In fact, almost all big food or packaging enterprises and also, industrial associations, have published their targets in respect of collection and recycling in 2025 and the successive years [15, 21].

The plastic materials, being most frequently employed in packaging intended for contact with food include Polypropylene (PP), marked with number 5 or 05 on packaging. The mentioned plastic is denser, harder and more transparent as compared to polyethylene. It shows good chemical resistance and is an effective barrier to water vapour [12, 19]. Different forms of polypropylene have different hardness and melting temperature. Polypropylene has a high melting temperature (160oC) what makes it more suitable for the applications where thermal resistance is required, e.g. in hot filing. It is employed in containers for yoghurt and margarine [22].

Plastic containers intended for food have the greatest participation in the market due to their low cost, small weight and functional advantages such as the possibility of heating up in microwave oven, optical properties and the availability in different dimensions and shapes [9, 22]. In connection with this fact, the effect of storage and heating up the food products in reusable packages on the safety and health of the consumer is meaningful.

Many consumers are not aware of the other sources of food contamination which may have a more serious impact on human health. For example, food may be contaminated with chemical substances at a very low concentration as a result of chemical reactions and migration from food packaging, especially in the case of plastic packaging (PPM) [16, 17, 20]. Accumulation of low levels of chemical substances, long-lasting exposure to chemical contamination may lead to chronic

intoxication [7, 14]. The impact on human health after the exposure to chemical contaminations (e.g. cancers, infertility) may last for decades; therefore, the frequency of incidence is unforeseeable and may be higher than in the case of biological contamination [10]. From among chemical contaminations, originating in food packaging, the compounds which interfere hormonal system (EDC) cause the greatest concern as the unfavourable consequences of some of them are irreversible [13, 8]. In fact, according to the World Health Organisation, the consequences of certain EDC are maintained for the generations [3].

THE RESEARCH MATERIAL

The test material included reusable plastic packaging (Polypropylene/05) intended to come into contact with food; they were obtained from commercial shops at the territory of Lublin. Five packaging types coming from different producers were chosen for the tests. They were numbered from 001 to 005. All packaging had printed marks of PP and/or 05 what indicated the type of the material used for their production, i.e. polypropylene and mark of the destination of a given packaging indicating the possibility of heating up in microwave oven.

THE RESEARCH METHODS

The tests of the global migration from the examined samples of food packaging to water model (simulant) liquids were carried out by complete immersion with the use of laboratory incubator, in accordance with PN-EN 1186 by the immersion method. The conditions of testing the migration and the simulant liquids were so selected as to satisfy the requirements of real utilization of the tested packaging in contact with the specified food products. Global migration was determined in conformity with the Commission Regulation (EU) 2020/1245 three times with each sample, using each time a new portion of food-imitating simulant liquid. The table given below shows the conditions of testing the migration.

DETERMINATION OF GLOBAL MIGRATION

After employment of the time of the test, i.e. 30 minutes, and 10 days of the contact of the selected packaging with the simulant liquids, the liquids were transferred to evaporating dishes, being earlier dried up to a constant weight, they were evaporated to dryness and dry residues, after drying to the constant weight were weighed with the accuracy to 0.001 mg. The global migration from the tested materials was determined for each type of the samples, prepared in three repetitions. The weight of the dry residues was determined also for the control samples after evaporation of simulant liquid. Additionally, the tests with the earlier application of microwaves of frequency equal to 2.45 Hz and power of 800 and 1000 W were carried out. To this end, before testing the migration, the samples of plastic packaging were subjected to the effect of the mentioned above waves for 2, 3, 5 and 10 minutes in direct contact with the simulant liquids; then the test of the global migration were conducted according to the description as given above.

CALCULATION OF THE RESULTS

The results were expressed in mg/dm^2 of surface of the packaging intended to come into contact with food, as the mean from three repetitions.

TAB.1. CONDITIONS OF TESTING THE GLOBAL MIGRATION IN THE SELECTED PACKAGING

Type of packaging	Simulant liquid	Time and temperature of test
- 001 PP (Polypropylene) colourless	3- % acetic acid	30 min - 100°C
- 002 PP (Polypropylene) colourless	Distilled water	10 days - 40°C
- 003 PP (Polypropylene) colourless	20 – % acetic acid	
- 004 PP (Polypropylene) colourless	3 – % acetic acid	
- 005 PP (Polypropylene) colourless	50 – % ethanol/water	

The level of migration was calculated according to the following formula:

$$M = \frac{m_a - m_b \cdot 1000}{S}$$

where:

M – global migration to simulant liquid, in mg/dm^2 of the surface of sample, intended to come into contact with food [mg/dm^2]

m_a – weight of the residues obtained after evaporation of simulant liquid where the tested samples were immersed [g]

m_b – weight of the residues, obtained after evaporation of the simulant liquid (control sample) [g]

S – area of the surface of the tested sample which remained in the contact with the liquid [dm^2]

THE RESULTS OF THE TESTS

The results of the global migration from the analysed reusable plastic packaging intended to come into contact with food have been given in Tables 2-10.

The examined global migration from the selected packaging to distilled water (Tab.2) amounted, from the lowest one equal to 3.05 mg/dm^2 for sample 005 to the highest one equal to 5.30 mg/dm^2 for sample 001. Somewhat different results were obtained for the global migration with the earlier application of microwaves (Tab.3); in such case, the lowest

TAB.2. GLOBAL MIGRATION FROM THE TESTED PACKAGING TO A DISTILLED WATER

Tested samples	Global migration (mg/dm^2)
	Conditions of test: 10 days, 40°C
Sample 001	5.30
Sample 002	3.20
Sample 003	3.10
Sample 004	4.15
Sample 005	3.05

results of migration were recorded for the sample marked as 002 and 003 in the range 3.15-3.40 mg/dm^2, (sample 002) and from 3.12 to 3.42 mg/dm^2 (sample 003), respectively. In the discussed test, any statistically significant differences between the employed time periods of the samples' exposure to microwave effect were not found; it may be, however, observed that the longer time of the microwave application affected the increase of global migration from the tested packaging to a small extent. On the other hand, we should mention that all the examined samples of reusable packaging were found in the standard for global migrations which is equal to 10 mg/dm^2. Utilization of distilled water as the simulant liquid facilitates obtaining information on the possibilities of storing food at pH >4.5 in the tested material.

Somewhat different relationship was recorded for the samples with the application of acetic acid as the simulant liquid

TAB.3. GLOBAL MIGRATION FROM THE TESTED PACKAGING TO DISTILLED WATER WITH THE APPLICATION OF MICROWAVES

Tested samples	Global migration (mg/dm^2) / Conditions of test - 10 days, 40°C							
	Time of microwave effect; 800 W				Time of microwave effect; 1000 W			
	2 min	3 min	5 min	10 min	2 min	3 min	5 min	10 min
Sample 001	5,35 ^{a}	5,35 ^{a}	5,40 ^{ab}	5,45 ^{b}	5,34 ^{a}	5,41 ^{ab}	5,44 ^{b}	5,47 ^{c}
Sample 002	3,15 ^{a}	3,22 ^{a}	3,18 ^{a}	3,40 ^{c}	3,14 ^{a}	3,26 ^{b}	3,31 ^{b}	3,39 ^{c}
Sample 003	3,12 ^{a}	3,21 ^{b}	3,30 ^{b}	3,42 ^{c}	3,12 ^{a}	3,25 ^{b}	3,29 ^{b}	3,44 ^{c}
Sample 004	4,20 ^{ab}	4,15 ^{a}	4,32 ^{c}	4,36 ^{d}	4,19 ^{ab}	4,21 ^{b}	4,38 ^{d}	4,43 ^{e}
Sample 005	3,33a	3,40 ^{ab}	3,45 ^{b}	3,45 ^{b}	3,42 ^{ab}	3,46 ^{b}	3,45 ^{b}	3,52 ^{c}

** a, b, c... means marked with the same letters do not differ statistically significantly at 5% error (Tukey test)

TAB.4. GLOBAL MIGRATION FROM THE TESTED PACKAGING TO 3-% ACETIC ACID

Tested samples	Global migration (mg/dm^2)	
	Conditions of test:	
	10 days, 40°C	30 min 100°C
Sample 001	6.10	5.87
Sample 002	4.18	5.15
Sample 003	5.22	6.11
Sample 004	4.25	4.72
Sample 005	3.25	3.89

(Tab.4-5). In such case, the lowest migration of plastic packaging was obtained for sample 005 i.e. 3.25 (conditions of migration: 3% acetic acid, time – 10 days, temperature 40°C) and 3.89 mg/dm^2 (conditions of migration: 3% acetic acid, time – 30 minutes, temperature 100°C); the highest one was found for sample 001 – 5.87 (conditions of migration: 3% acetic acid, time – 10 days, temperature 40°C) and 6.10 mg/dm^2 (conditions of migration: 3% acetic acid, time – 30 minutes, temperature 100°C). On the other hand, during the tests with the application of microwaves (Tab.5) there was recorded the lowest migration for sample 005 which increased together with the prolongation of the time of microwave exposure from 3.42 to 4.32 mg/dm^2. The sample marked as 001 revealed the highest global migration similarly as in the case of the test with the application of distilled water. During the test conducted in the conditions with the application of the higher temperature (30 minutes, 100°C), values of migration were higher as compared to the standard conditions what may indicate the lower stability of the packaging in higher temperatures.

The application of 3% acetic acid as the simulant liquid is universally employed with the purpose to assess the possibilities of storing food with acidic pH ≤4.5. From the analysis of the tests it is resulted that all the examined materials ensure the appropriate conditions for a long storage of this type of the food products.

The application of the exposure of the tested packaging materials to microwaves revealed that together with the prolongation of the time and power of the employed microwaves, global migration in the samples marked as 001 and 005 was increased. The employment of the higher power, i.e. 1000 W has also contributed to higher migrations. The discussed results suggest that it is safer to heat up the foods in glass containers than in those made from plastics. All results obtained in the mentioned study were, of course, found within the standard, although – as it was mentioned at the beginning of the present paper – the effects of the long-lasting exposure of human organism to the compounds derived from plastics may have the consequences in the future. Moreover, the obtained results indicate that in spite of the employment of the same plastics, we may observe considerable differences between the global migrations of the tested materials what may be evidence of a different quality of the produced packaging.

TAB.5. GLOBAL MIGRATION FROM TESTED PACKAGING TO 3% ACETIC ACID, WITH THE APPLICATION OF MICROWAVES

Tested samples	Global migration (mg/dm^2) / Test conditions – 10 days 40°C							
	Time of microwave effect; 800 W				Time of microwave effect; 1000 W			
	2 min	3 min	5 min	10 min	2 min	3 min	5 min	10 min
Sample 001	6,16 ^{a}	6,15 ^{a}	6,35 ^{c}	6,44 ^{d}	6,21 ^{a}	6,34 ^{c}	6,52e	6,60 ^{f}
Sample 002	4,42 ^{a}	4,55 ^{sb}	4,62 ^{b}	5,01 ^{c}	4,69 ^{b}	5,12 ^{c}	5,60 ^{d}	5,74 ^{e}
Sample 003	5,36 ^{a}	5,31 ^{a}	5,48 ^{c}	5,98 ^{e}	5,41 ^{b}	5,57 ^{d}	5,77 ^{e}	6,23 ^{f}
Sample 004	4,44 ^{a}	5,03 ^{b}	5,12 ^{bc}	5,48 ^{d}	4,89 ^{ab}	5,21 ^{c}	5,65 ^{e}	6,02 ^{f}
Sample 005	3,42 ^{a}	3,65 ^{ab}	3,98 ^{b}	4,32 ^{c}	4,02 ^{b}	4,14 ^{bc}	4,44 ^{d}	4,65 ^{e}

* a, b, c... – means marked with the same letters do not differ statistically significantly at 5% error (Tukey test)

TAB.6. GLOBAL MIGRATION

Tested samples	Global migration (mg/dm²) / Test conditions – 10 days 40°C							
	Time of microwave effect; 800 W				Time of microwave effect; 1000 W			
	2 min	3 min	5 min	10 min	2 min	3 min	5 min	10 min
Sample 001	5,87 a	5,93 a	6,11 b	6,42 d	5,96 ab	6,32 c	6,69 e	7,11 f
Sample 002	5,15 a	5,21 ab	5,54 d	5,55 d	5,25 b	5,43 c	5,61 e	5,63 e
Sample 003	6,11 a	6,05 a	6,23 b	6,33 c	6,18 b	6,25 b	6,22 b	6,46 d
Sample 004	4,72 a	5,01 b	5,16 c	5,21 c	5,03 b	5,42 e	5,24 cd	5,29 d
Sample 005	3,89 a	4,12 ab	4,32 b	5,51 f	4,53 a	4,97 d	5,29 e	6,62 g

* a, b, c... – means marked with the same letters do not differ statistically significantly at 5% error (Tukey test)

Similar relationships were obtained for the global migration, with the application of 20% acetic acid as the simulant liquid (Tab.7-8). In the standard conditions (10 days, 40°C), global migration varies from 6.50 mg/dm^2 to 8.00 mg/dm^2. When comparing to the previously discussed results, we may see the increase of the global migration in 20-% acetic acid. In this case, also in the samples marked with numbers 001 and 005, global migration increased together with the employment of higher power and together with the prolongation of the time of the microwave effect on the tested material. Values obtained for the applied power of 1000 W and 10 minutes were near to exceeding the permissible limit, i.e. 10 mg/dm^2. We should, however, mention that the obtained results were still found within the standard.

TAB.7. GLOBAL MIGRATION FROM THE TESTED PACKAGING TO 20-% ACETIC ACID

Tested samples	Global migration (mg/dm²)
	Test conditions – 10 days 40°C
Sample 001	6.50
Sample 002	7.20
Sample 003	8.00
Sample 004	7.43
Sample 005	6.69

TAB.8. GLOBAL MIGRATION FROM THE TESTED PACKAGING TO 20-% ACETIC ACID

Tested samples	Global migration (mg/dm²) / Test conditions – 10 days 40°C							
	Time of microwave effect; 800 W				Time of microwave effect; 1000 W			
	2 min	3 min	5 min	10 min	2 min	3 min	5 min	10 min
Sample 001	6,45 a	6,87 b	7,13 c	7,49 d	6,47 a	7,12 c	7,47 d	8,71 e
Sample 002	7,31 a	7,41 b	7,38 b	7,56 d	7,46 c	7,53 d	7,55 d	7,62 e
Sample 003	8,13 a	8,21 b	8,42 c	8,50 ???	8,28 b	8,31 b	8,44 c	8,64 d
Sample 004	7,39 b	7,27 a	7,41 b	7,53 c	7,44 b	7,57 d	7,72 e	7,81 f
Sample 005	6,74 a	7,02 b	7,21 d	7,69 g	7,12 c	7,67 e	8,51 f	8,80 h

* a, b, c... – means marked with the same letters do not differ statistically significantly at 5% error (Tukey test)

TAB.9. GLOBAL MIGRATION FROM THE TESTED PACKAGING TO 20% ACETIC ACID, WITH THE APPLICATION OF MICROWAVES

Tested samples	Global migration (mg/dm^2)
	Test conditions – 10 days 40°C
Sample 001	6.54
Sample 002	7.13
Sample 003	7.44
Sample 004	6.98
Sample 005	8.01

2. The highest results of the global migration were recorded for the samples with the application of 20-% acetic acid as the simulant liquid.
3. It was shown that the application of microwaves has the impact on the increase of the global migration from the tested samples. The time of the exposure of the effect of microwaves as well as the employed power had the influence on the increase of the global migration from the packaging to the simulant liquids.

TAB.10. GLOBAL MIGRATION FROM THE TESTED PACKAGING TO 50-% ETHANOL WITH THE USE OF MICROWAVES

Tested samples	Global migration (mg/dm^2) / Test conditions – 10 days 40°C							
	Time of microwave effect; 800 W				Time of microwave effect; 1000 W			
	2 min	3 min	5 min	10 min	2 min	3 min	5 min	10 min
Sample 001	6,49 ^{a}	6,51 ^{b}	6,51 ^{b}	6,53 ^{b}	6,55 ^{c}	6,51 ^{b}	6,62d	6,64d
Sample 002	7,21 ^{a}	7,34 ^{b}	7,33 ^{b}	7,41 ^{c}	7,19 ^{a}	7,35 ^{b}	7,42c	7,61d
Sample 003	7,39 ^{a}	7,46 ^{b}	7,55 ^{d}	7,50 ^{c}	7,49 ^{b}	7,62 ^{e}	7,66f	7,71g
Sample 004	7,12 ^{a}	7,16 ^{b}	7,26 ^{d}	7,21 ^{c}	7,21 ^{c}	7,35 ^{e}	7,68f	8,01g
Sample 005	8,23 ^{a}	8,29 ^{b}	8,31 ^{b}	8,34 ^{c}	8,34 ^{c}	8,52 ^{d}	8,61e	8,77f

* a, b, c... – means marked with the same letters do not differ statistically significantly at 5% error (Tukey test)

Tables 9-10 show the results of the global migration with the application of 50-% ethanol as the simulant liquid. The conditions of the test were adequate to the remaining simulant liquids. The tests revealed that all the examined samples were found within the standard what is evidence of the possibility of applying them in the storage of food, containing alcohol. The highest migration was recorded for packaging 005, i.e. 8.77 mg/dm^2, somewhat lower for sample 004 - 8.01 mg/dm^2 and the lowest one was found for 001 – 6.64 mg/dm^2.

CONCLUSIONS

1. In the present paper there was demonstrated that all the tested samples of reusable packaging intended to store and heat up food products were found within the standard of global migration amounting to 10 mg/dm^2.

Microwaves may affect the food packaging materials, causing their heating what, in turn, may change their physical and chemical properties. The fundamental mechanism by the help of which microwaves heat up the food consists in causing vibrations of water particles present in food, generating heat energy. The mentioned heat may be transferred on the packaging material having the contact with food and may cause the changes such as softening of melting of the polymers, especially when the discussed materials are not designed so as to resist the microwave temperature.

4. All the tested materials are suitable for the storage of hydrated food and alcohol-containing foods.

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ROLE OF AFFORDANCES IN PACKAGING DESIGNING

ROLA AFORDANCJI W PROJEKTOWANIU OPAKOWAŃ

ABSTRACT: The aim of the paper is to indicate the meaning of affordances for designing of packaging and their impact on the run of interactions between the user and the product. In the present article, the questions connected with the visual and sensual (touch) perception have been discussed; there has been also stressed how different types of affordances may affect the purchase decisions. We should pay attention to the fact the packaging which easily communicate their functions, may increase the satisfaction of the consumers.
Key words: affordances, utility, packaging designing, paper packaging, plastic packaging

STRESZCZENIE: Celem artykułu jest wskazanie na znaczenie afordancji dla projektowania opakowań oraz ich wpływu na przebieg interakcji użytkownika z produktem. Artykuł porusza kwestie związane z percepcją wizualną i dotykową, podkreślając, jak różne rodzaje afordancji mogą wpłynąć na decyzje zakupowe. Zwraca uwagę na fakt, że opakowania, które jasno komunikują swoje funkcje, mogą zwiększyć zadowolenie konsumentów.
Słowa kluczowe: afordancje, opakowania, użyteczność

INTRODUCTION

The contemporary designing of packaging plays a key role in the processes of communication between the product and the consumer, constituting one of the most important marketing instruments in dynamically varying market environment. In the conditions of the increasing competition at the global market where the consumers have an access to a wide spectrum of products in each category, packaging have become not only the carrier of information about the product but also the key element of constructing the image of the brand and creating the unique purchase experiences. Packaging is the first point of contact of the consumer and the product what makes that its role in attracting the attention is extremely significant. In this context, the appropriately designed packaging may effectively differentiate a product on a shelf, with the application of visual elements such as colours, typography, shape or materials which jointly create a coherent and attractive message. Apart from the obvious function of packaging, they have also the influence on the users via affordances. They determine the way how the individuals perceive the product and enter into a direct interaction with it; they make that the packaging becomes a link between the product and the consumer. Understanding of the discussed relations is not only crucial for designing of more effective and intuitional packaging but also for understanding wider social and environmental consequences, connected with consumption. In the context of growing eco-awareness and the progressing changes in the consumer habits, the affordances of packaging take on a new meaning. The way how the packaging facilitate the access to the products, their re-closing and also their final disposal or recycling, has a direct impact on environmental footprint of the products.

In the light of the above facts, the designers stay before the challenge not only in the respect of satisfying the needs of the users at the functional level but also, in ethical and environmental aspects.

THEORY OF AFFORDANCES

The idea of affordances has originated in ecological psychology and has been suggested by James Gibson (Kaptelinin, 2014,

p.5). He made a breakthrough in the field of visual perception when submitting the thesis that the objects as being found in our environment have a functional meaning for the observer. He formulated the term of affordances when defining it as " the possibility acting, including the practical function of the objects. He determined affordances as relationship between "the world and actors" (Gibson, 1986, pp. 127 – 135). We should however mention that Gibson did not focus his attention directly on affordances per se but he treated his conception in a practical way. The existence of affordances itself was not a key problem for him but the possibility of describing them via information contained in the perceptive accessibility of the surrounding world (Wachowski, 2014).

Donald Norman utilized the theory of affordances with the aim to employ it in the so-called "perceived affordances", that is, "perceiving the possibilities of utilization". They concern the specified attributes of the object such as shape, colour or material. The mentioned elements are expected to serve as guidelines in area of functionality; they trigger a concrete action of the user. The application of affordances in packaging designing is expected to cause the intuitional understanding of the object by the consumer and by this, eliminate the need of employing the instructions. Norman pays attention to the fact that the affordances should be intuitive as the simple things do not require explanation and the complex things need it; if a simple project requires instruction, the project is not reliable (Norman, 2013).

Donald Norman mentions rightly that in spite of the fact that affordances mean the possibilities of acting, they are useless when they are not noticeable by the users. Therefore, the task of the designer is to make them easily noticeable (Norman, 1999). Almost ten years after introducing the theory of affordances, Norman decided to make the idea of affordances more precise, and to pay attention to its incorrect application in designing (Norman, 1999, p.38-41). Then, he put forward even more radical thesis which recommended that the designer should focus on indicators and not on affordances. Introduction of the conception of the indicators is especially significant in the context of their relations with affordances. Norman pays attention that those mentioned above names are considerably differing terms which should not be confused. Affordances specify the action possible to be performed whereas the indicators help the users to discover the mentioned possibilities. They are easily perceivable signs or signals and they indicate what action the user has to perform (Norman, 2013). Norman precises the conception of indicators when defining them as any signal or type of sign, occurring in physical or social space which allows interpretation. It is important that the indicators supply the key information even when they appear accidentally in the product or in society (Norman, 2008). The indicator plays the key role in the process of communication with the user, irrespectively of the fact whether the intention of communication was intended or accidental. Kaptelin pays however attention that the differentiation proposed by Norman is not so obvious as it might seem. On the one hand, Norman introduces classification into the discussed above conceptions but on the other hand, he treats the indicators as the element entering the composition of affordances and sometimes, he even calls them as the perceived affordances (Kaptelin, 2014, p. 54).

APPLICATION OF AFFORDANCES IN PACKAGING DESIGNING

Interaction between man and packaging consists of many stages, commencing from the purchase, via utilization until its disposal. Well-designed packaging induce the immediate understanding of utilization – they give a direct perceptive signal concerning how to open the object, how to use it and then, how to close it (Chavalkul, Saxon and Jerrard, 2011). Krippendorff paid attention to the fact that the semantic issues, i.e. interpretation of the package meaning by the users had the priority in relation to ergonomic aspects, that is, the ways in which the consumer operated the packaging and how he utilized it (Kripopendorff, 2006, p.273-275).

Although the domain of packaging designing is developing with the aim to eliminate the numerous problems, encountered by the users during the implementation of specified tasks, the consumers still are faced with the different problems connected with the usability of the packaging. They include as follows: clarity, safety, visibility and availability of the product (Kesercioğlu, 2005). Negative experiences connected with the

mentioned problems may considerably affect the level of satisfaction during the use of the product and by this, lack of the will to buy it again (Löfgren, Witell and Gustafsson, 2008). Diversification of the requirements posed by the users results from the diversification of the products, their characteristics and applications. It is reflected in the complexity of the packaging designing process. In consequence, we have to deal with the situation where the possibility of creating the packaging on the grounds of universal set of requirements becomes difficult and by this, is especially desired by the designers (Abdellal, Mumani and Stone, 2018). In spite of the fact that there many studies which assessed the usability of packaging at various stages of their utilization, the mentioned methods not often enabled the identification of the main causes of the problems with the usability. Moreover, they have not defined the suggestions aiming at the improvement of the project of packaging (Abdellal, Mumani and Stone, 2018). Therefore, linking of the properties of the package and their functionalities becomes indispensable in the process of packaging designing. The discussed conception allows identification of the problems in respect of usability, resulting directly from the specified attributes of packaging (Fuente et al. 2015). Thus, the facilities, understood as real and perceived affordances, determine the possibilities of the object's utilization (Norman, 1988). Although the precise definition of the affordances' conception in relation to the packaging designing is problematic, it is possible to catch its essence using the typical properties of affordances, such as transparency of information, responsiveness and intuition (Hsiao, Hsu and Lee, 2012). If we consider the key role of affordances in facilitation of the mutual interactions between the user and packaging, which is offered via the properties of the packaging, the integration of affordance theory and methodology of packaging designing becomes significant. The analysis of correlations between the properties of the packaging and their affordances seems also to be meaningful (Abdellal, Mumani and Stone, 2018, p.65).

METHODOLOGY OF THE STUDY

PROBLEM OF THE STUDY

The aim of the study was to compare the perceptive properties of the users in relation to two different packaging for washing tablets which are characterized by different affordances. The mentioned study was aimed at identification of the specific properties of affordances, affecting the interactions and usability of packaging.

THE OBJECT OF THE STUDY

In the studies, two packages for washing tablets, characterized by different affordances, were employed. Packaging No 1 – plastic, oval shape, divided into two constructions (cover and bottom), opened by pressing two buttons and unscrewing. Packaging No 2 – paper, symmetric shape, one construction,

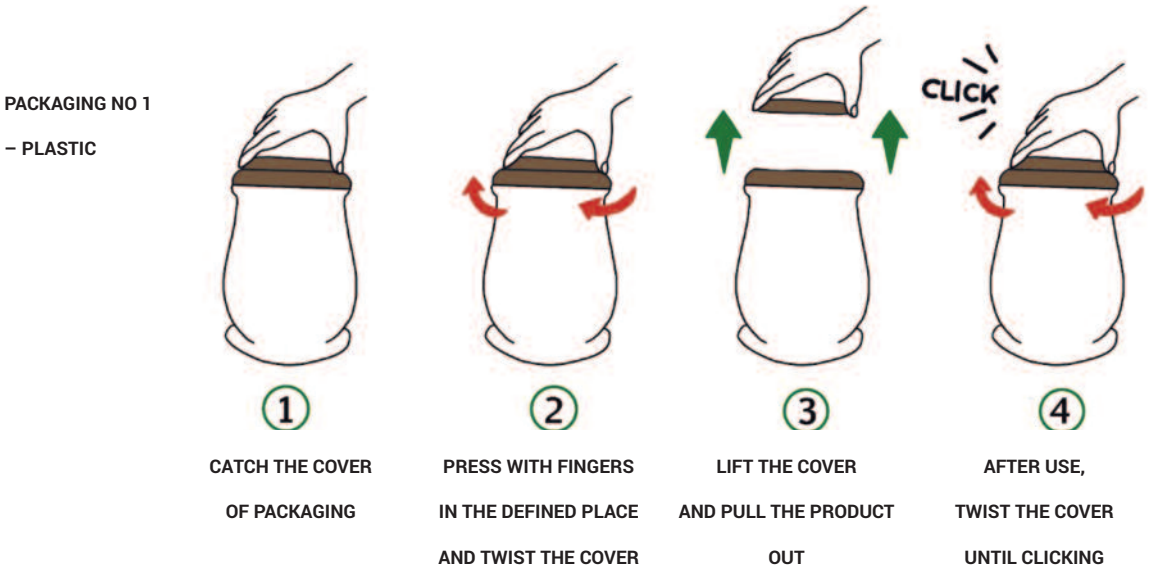

FIG. 1. INSTRUCTION FOR OPENING OF PACKAGING – OWN ELABORATION (THE PACKAGING DOES NOT CONTAIN INSTRUCTION OF PACKAGING USE)

PACKAGING NO 2 – PAPER

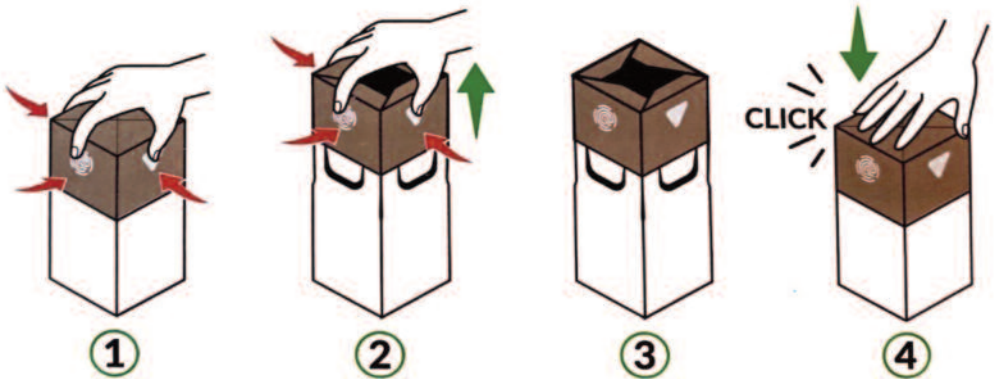

FIG. 2. INSTRUCTION FOR OPENING OF PACKAGING (IT IS FOUND DIRECTLY ON THE PACKAGING)

opening is performed by three locks which should be pressed and pulled up.

THE RUN OF THE STUDY

The test was carried out in the group of 40 persons aged 20-30. Twenty (20) persons received plastic packaging, and the successive 20 persons – paper packaging. The task of the users was to open the packaging, take the product out and to close the packaging and then, fill the survey, assessing the specified aspects of packaging, affecting its usability.

Elements of affordances to be assessed by the examined persons:

Openability (shape, material, size) – easiness of opening the packaging, intuitiveness, the possibility of acting

The way of holding (shape) – opening, closing the packaging, everyday use;

Storage (size, shape)

Disposal (material) – Easiness of packaging use

Closure (shape, material, size)

Safety – the appropriate protection from the accidental opening, e.g. by children

Packaging in general (all aspects) – packaging as a whole and its usability

THE RESULTS OF THE STUDIES

The results of the survey were performed using the questionnaire and the exported to Excel and categorized according to the repeating answers.

PAPER PACKAGING

As much as 65% of the respondents revealed the will to buy paper packaging in the future in spite of many problems connected with its opening and pulling the product out. The table given below shows the elements determining the purchase of the product in a given packaging in the future and those ones which affected the lack of will to buy the product again in the future according to 35% of the surveyed persons.

TAB. 1. JUSTIFICATION OF THE PURCHASE – PAPER PACKAGING

YES	Percent	NO	Percent
Ergonomics	30%	Opening	20%
Aesthetics	30%	Pulling the product out	10%
Ecology	25%	The possibility to damage the packaging in bathroom	5%
Size	20%		
Practicability	15%		
Safety	15%		

Source: own development on the grounds of the studies – M.Sc. thesis

PLASTIC PACKAGING

As much as 80% of the respondents revealed that they would not buy the product in paper packaging again in spite of the fact that they did not show any problems with opening of the packaging or pulling out the product.

TAB.2. JUSTIFICATION OF THE PURCHASE – PLASTIC PACKAGING

YES	Percent	NO	Percent
Resistant	10%	Size	60%
Aesthetic	5%	Shape	30%
Functional	5%	Closure	10%

Source: own development on the grounds of the studies – M.Sc. thesis

GENERAL CONCLUSIONS

If we ascribe a defined component of the packaging to each functionality, offered by the mentioned packaging, we will notice which one has a negative or positive impact on the user and which elements require modification, resulting in perception of the packaging as more usable and, consequently, more desired by the users. Table 3 represents the comparison of two types of packaging on the grounds of the respective categories. "Plus" means that a given packaging occurred to be better in a given category as compared to another one and "minus" means that a given packaging was assessed as worse.

Symmetric shapes of packaging are decisively favourable for their use and, in particular, storage of the products in the packaging of the discussed type. In turn, the packaging, having the oval shape are often perceived as less practicable and non-aesthetic. Their irregular shape may cause the troubles with their effective storage as they do not fit well to regular, rectangular storage space. The mentioned perceptions affect the everyday dosage of the product; the mentioned packaging may be more difficult in handling and control of the product's removal, especially when they are often used. The shape of the packaging, as having the direct impact on ergonomics of use and optimization of the storage processes, is more important for the consumers as the mechanism of the package opening. The users are capable of adaptation and learning how to operate the packaging. Even if at the beginning the mechanism of opening is not intuitive for them, it may become more understandable after few times of application. On the other hand, the users do not have influence on geometric configuration of the packaging, being a constant parameter.

During the packaging designing, it is necessary to pay attention to specific needs and expectations of the particular groups of the users. To be more precise, in the case of the products which have to be used mainly by women, it is important to consider such factors as the length of the nails. The long nails may become the barrier in easy opening of the packaging, especially of those ones which require application of certain force or a precise holding. For example, the packaging with small, flat caps may be difficult to be opened by the persons with the long nails what may cause frustration and decrease a general satisfaction coming from the product.

The presence of three locks from which one is different than the two remaining ones caused a logic limitation among the users and it was difficult to cope with them. The tested persons had a problem with opening of the packaging in the way recommended by the producer due to the size of the packaging

TAB.3. COMPARISON OF THE ELEMENTS OF PACKAGING – ACCORDING TO CATEGORIES

Category	Paper packaging	Plastic packaging	Element of packaging
Opening	-	+	Mechanism of opening
Holding	+	-	Shape, size
Storage	+	-	Shape, size
Disposal	+	-	Material
Pulling the product out	-	+	Construction
Closing	+	-	Mechanism of closing
Safety	+	-	Mechanism of opening, closing
Usability	+	-	Total

Source: Own elaboration on the grounds of the studies – M.Sc. thesis

in relation to hand. The discussed phenomenon indicates the necessity of considering ergonomics when designing the packaging in order to ensure their functionality and availability, especially in the context of safe application by the adult persons, with the simultaneous keeping the appropriate protection, making the access of the children impossible.

The choice of the same colour game for separate functional elements of the packaging such as enclosures or pressing buttons, may lead to their perception by the users as the uniform integrity. Although it may be the intentional visual operation, it may cause a risk of cognitive dissonance when the users are not able to discriminate intuitionally the functions of the particular parts of the packaging. The dimensions of the packaging (the size) have a meaningful impact on the first impression of the user what, in turn, shapes its later perception of other aspects of the packaging. Too big packaging is often negatively perceived by the consumers, determining the purchase decisions.

Certain aspects which seem to be crucial for the usability of the packaging such as mechanism of opening and comfort of taking the product out, do not have the a significant effect on the decisions of the consumers concerning the purchase of the product again in the same packaging. Therefore, the re-definition of the priorities in the packaging designing, indicating the focusing on the other aspects such as material or shape which may more effectively affect the purchase decisions, seems to be significant.

SUMMING UP

Visual attractiveness of packaging has a significant impact on the purchase decisions of the customers but it is functionality which determines long-lasting involvement of the consumer and choice of the product in a given packaging in the future. Affordances play a crucial role in shaping of the usability and interactions with the packaging, affecting the comfort of use as well as the consumer choices. The strategic utilization of the theory of affordances and ascribing them to the specified elements is significant in designing of the packaging. It gives the background for creation of packaging, satisfying the perceptive needs of the users.

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FACHPACK 2024: NUREMBERG IS HOSTING EUROPEAN PACKAGING INDUSTRY

From September 24 to 26th, 2024, the European packaging sector will once again gather at FACHPACK, the trade fair for packaging, technology and processes. More than 1,400 exhibitors at Exhibition Centre Nuremberg will showcase packaging materials and accessories, packaging machines and technology as well as the key processes for automation, marking and labelling, packaging printing and intra-logistics.

The main theme of FACHPACK this year is "Transition in Packaging", which aptly describes the changes currently taking place in the industry that will also be reflected in the 11 exhibition halls and high-calibre supporting programme. Visitors from the consumer and industrial goods segments can look forward to an extensive programme of presentations in the PACKBOX, INNOVATIONBOX and SOLPACK 5.0 forums as well as interesting special shows and awards ceremonies.

Heike Slotta, Executive Director Exhibitions at Nürnberg-Messe, is upbeat: *Following our scheduled break in 2023, we are now heading towards the home straight for FACHPACK 2024. The preparations are in full swing and everything is coming together. I cordially invite all packaging specialists to come to the exhibition centre in September: We create the future, so make sure that you're part of it!*

FACHPACK 2024 AT THE HEART OF EUROPE

A particularly welcome aspect is that FACHPACK 2024 is positioning itself as a continent-wide event, with fifty-four percent of the exhibitors coming from abroad, the rest from the strong German-speaking economic area and neighbouring

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countries. This applies also for new exhibitors that account for around 20 percent of all exhibitors at FACHPACK 2024. A remarkably high proportion of these – 70 percent – come from countries other than Germany.

FORUMS ON INTERESTING TOPICS PROVIDE NEW IMPETUS IN THE SUPPORTING PROGRAMME

FACHPACK sees itself as a source of inspiration for the industry. Alongside the extensive product display, this is also reflected in the programme of presentations in the three forums PACKBOX, INNOVATIONBOX and SOLPACK 5.0. All three forums address topical issues affecting the sector, e.g. dealing with the new PPWR regulations, the circular economy, automation and AI, or alternative packaging solutions and new fibre raw materials.

The ambitious goal of EU Packaging Directive PPWR, the regulation which for sure will certainly attract particular attention, is to reduce waste and lower environmental pollution. Companies are being urged to invest in new and more environmentally compatible solutions. Greater transparency for consumers through improved labelling requirements is now also mandatory. So far, so good. However, considerable criticisms about the legislation have also been raised by various industry players, for example regarding the practical feasibility of the required recyclability and use of recyclates, particularly in food contact applications. The burden on SMEs is another criticism. The PPWR is therefore a balancing act between ecological responsibility and economic viability that will largely set the course for future European environmental and economic policy. At FACHPACK, this topic will be much discussed and hotly debated.

Key partners from the packaging industry are designing the programme for PACKBOX and invite interested participants to listen or join in the discussions. This forum will be moderated by three genuine industry stalwarts: Matthias Mahr from the trade journal LebensmittelPraxis (24./25.9), Dr Johannes Bergmair from Pack Experts and the World Packaging Organisation (WPO) (25.9.), and Oliver Berndt from the German Packaging Institute (dvi) (26.9.). In the INNOVATIONBOX Forum, registered exhibitors will introduce their new products and process innovations in a series of concise presentations. Popular moderators Nina Schönrock and Petra Bindl will host the programme. The SOLPACK 5.0 Forum is devoted to sustainable packaging solutions and will be conducted and moderated by Peter Desiléts and Volker Muche, managing directors of packaging design agency Pacoon GmbH.

GATHERING FOR THE INDUSTRY OFFERS THREE DAYS OF NETWORKING AT ITS FINEST

In keeping with its slogan “We create the future”, FACHPACK offers the ideal platform for networking. A new feature in this context is the networking event Women4Packaging for women

in the packaging industry which will be held on the first day of the fair. It offers female players in the sector a unique opportunity to network at the venue, inspire one another, and discuss the latest topics and trends in the packaging industry. Likewise on the first day of the fair, a total of 41 winners of the most prestigious European showcase for packaging excellence, the German Packaging Award, will be invited to take their places on the stage. Almost 250 submissions from 13 countries were received for consideration by the jury. The German Packaging Award is presented by the German Packaging Institute (dvi) and during the evening the winners in ten categories will be announced. As a premium partner, FACHPACK presents a special award for young talent. This accolade honours the best packaging concepts by school and university students and trainees.

ALTERNATIVE PACKAGING SOLUTIONS AND INNOVATIVE NEWCOMERS

This year, FACHPACK is introducing an inspiring programme feature: the "Alternative Packaging Solutions Pavilion", which will showcase examples of alternatives for commonly used materials and provide insights into what might be possible in the future. At the fully booked pavilion 13 companies will present their solutions including compostable plastic bags and teabags, upholstery material made from grain husks, packaging made from sugar cane (bagasse) and a whole lot more. The SOLPACK 5.0 Forum is also part of this pavilion. A total of 35 packaging experts and exhibitors will conduct short presentations.

Anyone looking for fresh, unconventional ideas and products to resolve packaging issues will find them again this year among the start-ups of the packaging segment in the "Young Innovators" pavilion for innovative young companies. In addition, the "Newcomer Pavilion" gives FACHPACK debutants or international newcomers a platform for presenting their companies and innovative products to a professional audience. Naturally, FACHPACK 2024 would not be complete without the popular "Labels & More".

GOOD PACKAGING DESIGN ON DISPLAY IN SPECIAL SHOW "OUTSIDE THE BOX"

Anyone interested in packaging design should swing by the special design show "Outside the Box". Curated by bayern design on behalf of FACHPACK, it maps the drafting and design journey from the initial idea through to good packaging design and provides valuable insights into the impact of design in development processes. It also explores how designers, as creative partners in the development process, find solutions to satisfy technical, ecological and economic requirements for packaging. Using unusual exhibits such as innovative packaging for fitted sheets or a reusable system for household products like detergents or soap, it presents design processes that enhance the circularity of packaging, make the brands behind the products more accessible, and foster identification and awareness among customers and users.

From September 24 to 26th, 2024, the European packaging sector will once again gather at FACHPACK, the trade fair for packaging, technology and processes

PACKAGING INNOVATIONS 2024: THE PLACE TO VISIT

The 16th edition of PACKAGING Innovations trade fair, organized by Targi w Krakowie, will soon take place on October 9-10th at EXPO Krakow exhibition center. The renowned event is visited by thousands of guests from Poland and abroad every year. This time its formula has been expanded to include additional formats, while retaining those familiar from previous editions. Thereby upcoming event will consist of a conference, a networking and exhibition zone, jubilee of the trade partners, exhibitions, as well as a media and career zone and the settling of the 13th Student Zone Contest.

Preparations for PACKAGING Innovations have been going on all year. Thousands of calls made and countless emails sent will result in two days' event, with organizers trying with all might to set the bar higher and higher each year. They attach great importance to the accompanying program, so that it reflects the most up-to-date trends and addresses a variety of issues. The guests appreciate it, attending meetings with invited experts in large numbers. It's worth mentioning that participation in the event is free of charge, which is not typical any more in the era of numerous training courses and professional conferences.

PACKAGING INNOVATIONS CONFERENCE

Understanding the attendants' need for developing and constantly updating their knowledge, organizers of PACKAGING Innovations are inviting respected experts to participate. The conference is part of Polish edition of Circular Week 2024 organized by the event's partner, the INNOWO Institute for Innovation and Responsible Development. It will take place on the Main Stage and Agora Stage, where the industry's most pressing issues, case studies and best practices will be presented, along with discussions about: "Prospects for the packaging industry in the light of the latest macroeconomic trends" (with speakers Krzysztof Mrówczyński and Paweł

Kowalski from Bank Pekao SA), "Designing packaging for recycling" (Dr. Renata Dobrucka, Professor at Poznań University of Economics), "Protection of industrial design in Poland and Europe" (Dr. Arkadiusz Michalak), "Regulatory challenges for packaged products in closed-loop economy" (Tomasz Wagner from ALTO), "Assessment of the packaging' environmental footprint in the context of ESG reporting" (Tomasz Nitkiewicz, Ph.D., Prof. of the Czestochowa University of Technology, Natureef Association) or "Endless recycling" (Bartłomiej Wojdyło from the CANPACK Group, RECAL Foundation). There will also be an expert debate on bioplastics with the participation of scientists and industry representatives. The full program of the conference, sponsored by Dako Drukarnia, is available on the event website.

JUBILEES OF PACKAGING INNOVATIONS PARTNERS

On the first day, October 9th , an anniversary ceremony for event's partners will take place on the Main Stage in the Wisła exhibition hall at EXPO Krakow: The 30th anniversary of the Polish Chamber of Packaging and the 60th anniversary of the Faculty of Industrial Design at Academy of Fine Arts in Krakow. Introductory word will be delivered by Krzysztof Niczyporuk, President of the Polish Chamber of Packaging, and Barbara Widłak, Ph.D., Professor at the Academy of Fine Arts in Krakow, Dean of the Faculty of Industrial Design. A jubilee exhibition has been prepared, including an exhibition of the Packaging and Typography Design Studio, whose manager, Monika Wojtaszek-Dziadusz, PhD, Professor of the Academy of Fine Arts, will give a lecture on innovative solutions in packaging design.

In Wisła exhibition hall at EXPO Krakow the attendants will have a chance to visit the Jubilee Exhibition of Packaging by the Olza Factory, which was prepared on the occasion of the 100th anniversary of the production plant in Cieszyn.

DIVERSE RANGE OF EXHIBITORS IN THE EXHIBITION AREA

The exhibition area will feature both domestic and foreign manufacturers and suppliers. At their booths there will be presented both finished packaging and materials for its production, machinery and logistics services and much more. Thanks to the diverse offer it will be possible to take a close look at the entire packaging production process from A to Z. The exhibition will include seven thematic zones: Packaging, Components, Machinery, Printing, Logistics and e-commerce, Services, Branding and Advertising. This makes it well worth planning your time to get fully acquainted with the range of products and services on display. Companies such as Berry Global, VideoJet, Pulp-Tec, Unobrand, PK System, EPSON, HSM, Robatech, Buehnen, Novo-Pak, Techpak, FIGE Polska and Multipress Printing House, among others, have confirmed their participation.

THE YOUTH POWER: 13TH STUDENT ZONE CONTEST

It is worth attending this year's edition of Student Zone Contest. The certification by World Packaging Organisation (WPO), the organiser of the World Star Student Awards, and its opening for foreign students resulted in a large number of ntries. The event's participants – numerous visitors and the exhibitors themselves – are keen to engage with the finalists of the competition by visiting them in a specially prepared zone where they present their projects. The winners will receive, among other things, the opportunity to take part in the aforementioned World Star Student Awards and the chance to receive a special prize from the event's partner, the Association of Applied Graphic Designers, which is the participation in its mentoring program. The winners will be announced on October 10th.

Detailed information is available at
www.packaginginnovations.pl.

Packaging Review

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  - ensure that there is no conflict of interests – they should have no personal relationships or business relations with Authors,
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- Articles must be original, not previously published (if the article is a part of another work i.e. PhD thesis, habilitation etc. the information about that should be placed in the reference section).
- The article should involve a narrow topic but treated thoroughly without repeating general knowledge information included in the widely known literature.
- If the problem is extensive, it should be it split into few articles for separate publications.
- Articles should be of a clear and logical structure: the material should be divided into parts with titles reflecting its content. The conclusions should be clearly stated at the end of the paper.
- The article should be adequately supplemented with illustrations, photographs, tables etc. however, their number should be limited to absolute necessity.
- The title of the article should be given in Polish and English as well as the abstract and key words.
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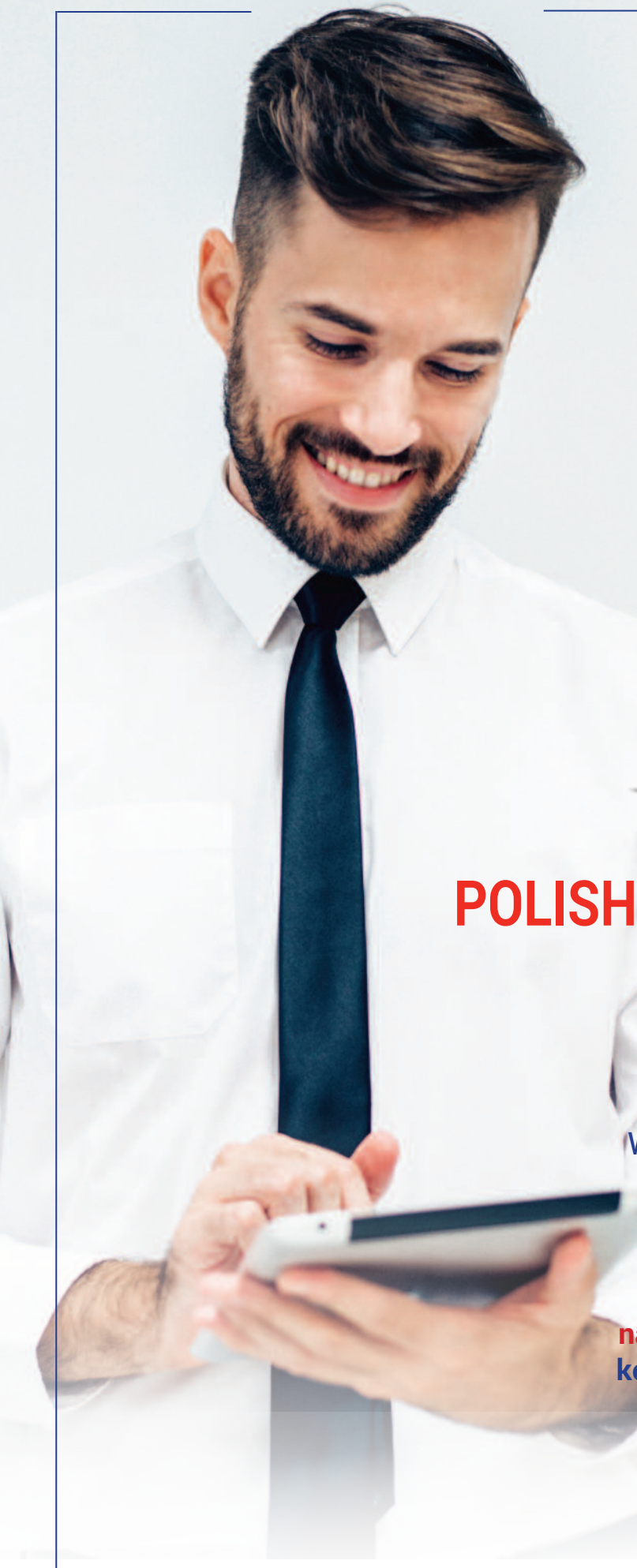

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