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COMPOSTABILITY OF DECORATIVE PAPER TISSUE NAPKINS

KOMPOSTOWALNOŚĆ PAPIEROWYCH SERWETEK DEKORACYJNYCH NA PODŁOŻU TISSUE

ABSTRACT: When choosing the products, consumers pay more and more attention to ecology. The environmental protection begins to play a meaningful role in everyday life. Ecology means not only the produced materials intended or suitable for recycling but also the increase of the interest in reusable products and innovations such as compostable materials. The market is aiming at ecological solutions, utilizing the alternative natural materials and being adapter to the financial possibilities of the customers.
Key words: compostability, biodegradability, eco-toxicity

STRESZCZENIE: Konsumenci wybierając produkty coraz większą rolę przypisują ekologii. Ochrona środowiska zaczyna odgrywać istotne znaczenie w codziennym życiu. Ekologia oznacza nie tylko materiały wykonane czy nadające się do recyclingu, ale również wzrost zainteresowania produktami wielokrotnego użytku oraz innowacjami takimi jak materiały kompostowalne. Rynek zmierza w kierunku rozwiązań ekologicznych, wykorzystujących alternatywne materiały naturalne i dostosowanych do portfela klienta.
Słowa kluczowe: kompostowalność, biodegradowalność, ekotoksyczność

INTRODUCTION

When summing the year 2023 in packaging sector, the paper industry portal juxtaposes two words: economy and ecology. The consumers play more and more attention to ecology aspects and the producers seek for the solutions which would optimize the budget. The market evolves towards ecological solutions. 75% of Poles ascribe a significant role to environment protection in everyday life; moreover, ecology means the increase of interest in reusable products and also, the innovations such as compostable materials [9]. The decorative paper napkins are not a packaging as the play, first of all, a decorative function. We use them for the decoration of tables during parties and ceremonies; for wiping our hands and mouth, we place also cakes on them and wrap foods for a short period of time. In connection with the above, they are subjected to many legal regulations which concern the products in contact with food. At the same, after use, they become the waste which should be managed. Therefore, the compostability is the solution which may contribute to the reduction of the quantity of mixed waste.

THE BASIC REQUIREMENTS CONCERNING COMPOSTABILITY

Compostability is a capacity of biodegrading of the material in compost environment in effect of which humus (natural fertilizer) is generated. Material is defined as compostable when, as a result of its decomposition in the environment, any eco-toxic substances are not generated. Moreover, biodegradation products must undergo disintegration into fraction of undistinguishable size in finished compost; they cannot also affect negatively the quality of compost [6]. If the compost is to become the substrate for plant cultivation, the content of eventual toxic degradation products (inter alia, heavy metals, polychlorinated biphenyls or dioxins) in the emerging compost cannot exceed the level admitted by standards [4].

The assessment of the suitability for composting is carried out on the grounds of PN-EN 13432:2002 Packaging Requirements for packaging recoverable through composting and degradation – Test scheme and evaluation criteria for the final acceptance of packaging[1]. The introduced European standard is harmonized with Directive 94/62/EC of the European Parliament and of the Council of 20 December 1994 on packaging and packaging waste. Directive 94/62 EC supports in particular, the development of the European standards relating to:

- criteria and methodologies for life-cycle analysis of packaging,
- the methods for measuring and verifying the presence of heavy metals and other dangerous substances in the packaging and their release into the environment from packaging for appropriate types of packaging,
- criteria for recycling methods,
- criteria for composting methods and produced compost,
- criteria for the marking of packaging.

PN-EN 13432:2002 together with other standards may be employed for confirmation that the packaging, as intended for introduction into the market, satisfies the principal requirements, as laid down in Directive 94/62/EC. The basic functions of packaging include storage and protection of products and facilitation of transport and presentation of the product. The organic recovery of post-use packaging is one of a few methods of recovery which end the life cycle of packaging. In order to save the natural resources and minimize the amount of the waste, it is recommended to optimize the whole system, connected with the packaging. The mentioned optimization includes preventing the generation of the waste as well as multi-use and also, recovery of packaging waste.

The evaluation of the suitability of packaging and its elements for biological treatment should cover at least the following 5 procedures:

- characteristics of material,
- biodegradability,
- disintegration, including the products of biological treatment
- quality of compost,
- identification of materials, what means that they should be recognized as compostable and biodegradable by final users.

Characteristics of material means that each considered material should be identified and characterized before tests, at least in the following way:

- supply of information on the components of packaging materials and their identification,
- indication of the presence of dangerous substances, e.g. heavy metals

TAB.1. MAXIMUM CONTENT OF ELEMENTS IN PACKAGING MATERIAL AND IN THE WHOLE PACKAGING

SOURCE: PN-EN 13432:2002

Element	mg/kg of dry matter	Element	mg/kg of dry matter
Zn	150	Cr	50
Cu	50	Mo	1
Ni	25	Se	0,75
Cd	0,5	As	5
Pb	50	F	100
Hg	0,5		

1 The present standard is translation of English version of European standard EN 13432:2002 Packaging Requirements for packaging recoverable through composting and degradation – Test scheme and evaluation criteria for the final acceptance of packaging

– determination of the content of organic carbon, dry matter and volatile constituents in packaging materials, used in biodegradability and disintegration tests.

In the case of heavy metals and other toxic and dangerous substances, their maximum levels have been determined; their content should not exceed values, given in Table 1.

It has been adopted that biodegradability should be determined for each material or its significant organic component; the significant organic component is considered as each organic component the content of which exceeds 1% of dry matter of material. On the other hand, the total participation of organic components, without determination of their biodegradability, should not exceed 5%. The tests of biodegradation are carried out in aerobic conditions; the time of the tests should amount to maximum 6 months. The biodegradation expressed in percentage for the tested material should be equal to at least 90% of the whole or 90% of maximum degradation of the respective reference substance after reaching the optimum level for the tested material and the reference substance. For the composting process lasting maximum 12 weeks, it is required that no more than 10% of dry matter of the tested material is remained on the sieve of the mesh size equal to 2 mm.

To meet the requirement of eco-toxicity, the indicator of the sprouted seeds and the increase of vegetal mass for two species, as conducted on the samples of the tested compost, should constitute more than 90% in relation to reference compost.

CERTIFICATION OF COMPOSTABILITY ON THE EXAMPLE OF DECORATIVE PAPER NAPKINS, PRODUCED IN PRINTING PLANT POL-MAK SP. Z O.O.[2]

Tissue paper is a basic raw material for production of decorative paper napkins[3]. In connection with the fact that POL-MAK Iława is producer of the tissue paper, obtaining of certificate which would confirm the compostability of napkins included, first of all, conducting the studies of compostability of tissue paper. The tests were outsourced to one of the laboratories, indicated by the certifying body. The test consisted of three parts:

– determination of the content of heavy metals;
– biodegradability;
– eco-toxicity.

In the first stage of the tests, the following results of the determination of heavy metal contents, as given in Table 2, were carried out. The heavy metals, as identified in the sample, are found within the limits indicated by PN-EN 13342:2002.

The next stage covered test of degradation. The degradation test under the defined composting conditions at the pilot scale is a standardized process of composting. The experimental material (decreased to dimensions: 10 cm x 10 cm for film and 5 cm x 5cm for the remaining products) is mixed in a precise concentration with the fresh bio-waste and is introduced to a defined composting environment; then, the process of biological composting is spontaneously commenced. The natural, universally present population of microorganisms begins the process of composting. The compost mass is regularly turned over and mixed. Temperature, pH, humidity

[2] Printing Plant POL-MAK was founded in 1986. Owing to confidence of the Customers it has been a leader on the national and foreign market of decorative paper products. As being a family company, it takes care – for the whole time – of the consequent and thoughtful development. The products, from the beginning up to the end, are manufactured in Poland. They are characterized by a high quality, carefully selected raw materials and refinements. The napkins, dishes, cups, bags and gift papers accompany the Customer in the most important moments of their life, generating the family and solemn atmosphere; they allow spending wonderful moments with the family and friends. The qualified employees are extremely important element of the company's development. Skills and involvement of the workers facilitate offer of wider and wider spectrum of the products of the world quality. Pol-Mak is striving at observation of social and environmental standards in the whole supply chain, from obtaining of raw material until the supply of final user. The company has made the obligation to implement the sustainable development and bear the responsibility for economic, social and ecological effects of production.

[3] The concepts of paper and cardboard are not univocal and they are often confused. One of the most popular classifications is based on paper density (unitary weight). The employed terminology is also differentiated according to the country and even producers. Polish paper industry uses sometimes also customary classification according to which paper products are classified into tissue paper (up to 28 g/m2), paper (from 28 g/m2 to 160 g/m2), paperboard (from 160 g/m2 to 315 g/m2) and cardboard - above 315 g/m2 [3]. Due to not very precise definitions and lack of univocal nomenclature during purchase-sale transactions, paper weigh as well as format are usually used and the terminology is an intuition question.

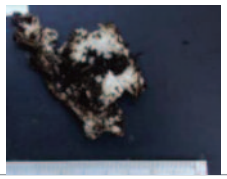
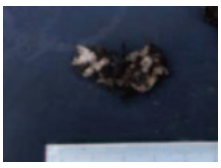
TAB.2. HEAVY METALS' CONTENT – THE RESULTS OF ANALYSES

SOURCE: REPORT FROM THE TESTS CONDUCTED IN OUTSOURCED LABORATORY

Chemical element	Value mg/kg (dry matter)	Chemical element	Value mg/kg (dry matter)
Zn	2.09±0.82 50	Cr	0.80±0.24
Cu	0.56±0.17	Mo	0.051±0.029
Ni	1.04±0.31	Se	n.d.
Cd	n.d.	As	n.d.
Pb	0.073±0,019	F	n.d.
Hg	n.d.		

TAB.3. PARAMETERS AND VISUAL OBSERVATIONS

SOURCE: REPORT FROM THE TESTS CONDUCTED IN OUTSOURCED LABORATORY

Week	pH	Moisture % (w/w)	O2 %	Observation of color, erosion, consistency and odour	Picture (The pictures are illustrative and not representative of the whole specimens)
Start					
2	8.6	51.0	>10%	The specimens show change in color and structure.	
4	8.6	45.3	>10%	The disintegration process begin.	
6	8.8	48.0	>10%	All the specimens are broken.	
8	8.3	46.7	>10%	The pieces are decreasing in size.	
10	8.1	46.1	>10%	Small pieces are still distinguishable from the compost	---
14	7.9	49.3	>10%	No pieces are still distinguishable from the compost	---
18	7.9	47.7	>10%	No pieces are still distinguishable from the compost	---
180 days	7.5	45.6	>10%	No pieces are distinguishable from the compost even after the sieving procedures	---

and composition of gas in the compost material are regularly monitored and they must satisfy the defined requirements as to ensure the sufficient and appropriate microbiological activity. The process of composting is carried on until the moment of obtaining the completely stabilized compost (after 180 days). The results of degradation are given in Table 3. At the end of the composting process, the mixture of compost and test material is filtrated on sieve with the meshes of 2 and 10 mm. If possible, the balance of mass is calculated on the grounds of wet and dry matter content. Compost obtained at the end of composting process may be used for further measurements such as chemical analyses and tests of eco-toxicity.

Test of eco-toxicity is commenced from the preparation of test soils. Plastic utensils (tray for the seeds) containing minimum 200 g of each compost (reference soil, test mixtures and blank sample) were filled and at the top, 100 seeds were laid on directly after preparation of the test mixture or up to 24h later. The seeds were not soaked before their planting and were covered with a thin layer of neutral material. The tests were carried out in three repetition of each mixture. Water was added until obtaining 70-100% of water content. Gradually, depending on the needs, the evaporated water was periodically added during the whole period of the test. During the sprouting stage, the trays were kept in darkness. The conditions of the test were similar to those indispensable for a normal growth of the tested species and varieties. The pots were placed in a room with a controlled temperature and humidity; the temperature was controlled via ventilation, heating and/or cooling systems. During the test, the following conditions were employed:

- temperature: 22°C±3°C,
- humidity: 60%±10%,
- photoperiod: minimum 16h of light,
- light intensity: 7000 lux

The trays for the seeds were periodically changed to minimize the variation of the plant growth (due to the differences in the test conditions in the cultivation objects).

During the observation period, 14 days after emergence of 50% of the control plants, the plants were observed in aspect of occurrence of visual phytotoxicity and mortality. In the 14th day of the test, a part of the test plants was randomly selected and the following final parameters were measured:

- number and percentage of plant emergence as compared to the blank compost;
- fresh mass (biomass);
- visible detrimental effects for different parts of the plants.

FIG.1. EXAMPLES OF MARKING THE COMPOSTABLE PRODUCTS

SOURCE: PROJECTS OF POL-MAK

The rate of germination and biomass were expressed as a percentage of the respective values, obtained for the blank compost. In connection with the fact that the tests showed that the rate of germination and biomass had exceeded the specification indicated by EN 13432:2002, it was adopted that any negative effect on germination and growth of the tested plants was not observed.

The above mentioned tests confirmed the suitability of tissue paper for composting.

For printing of napkins, based on paper tissue, the flexographic water-based inks are employed. To have the final product certified, all the raw materials, used in production, should be certified. In connection with this fact, the certified inks should be used in production within the limits consistent with the certificate possessed by ink producer. When having the certified raw materials, there were obtained the products which were subjected to certification. In effect of the certification process, the mentioned products are compliant with the requirements of EN 13432:2002 concerning the compostable products. Paper napkins which meet the requirements of compostability are market by the producer with logo ok compost (Fig.1)

CONCLUSIONS

The market of compostable materials in Poland has currently the innovative and niche character but, at the same time, perspective one. When striving at its development, we should undertake the innovative ventures to respond to activators and supporting factors as well as problems and barriers. The consumers become to understand the meaning of procedure consistent with the spirit of ecological thinking; marking of the products will serve this purpose. Many consumers, as being convinced about the easy biodegradability of materials, marked with the appropriate sign, will throw them away to home composters or even simply throw them away as they think that in natural environment they will be subjected to quick and harmless degradation. The basic difference between the compostable and biodegradable materials consists in the fact that the compostable products require the special conditions to be degraded whereas the biodegradable products are degraded in a natural way. Composting is usually the quicker process but it requires controlled conditions (appropriate humidity and temperature and oxygen presence). On the other hand, lack of coherent program of management of the waste coming from compostable materials, in connection with the lack of the appropriate education of the society in this respect and the non-univocal system of marking the packaging intended for composting may lead to discourage of the consumers from the appropriate segregation of the mentioned materials. Moreover, the discussed problem includes also lack of uniform and transparent regulations concerning planning and organization of closed economy of compostable packaging. The lack of the consumers' awareness of the significance of the packaging problem, lack of education (e.g. in schools and social media) and information campaigns concerning bio-packaging (including compostable packaging), or e.g. deficit of mobile applications, supporting the popularization of knowledge on the waste segregation as well as lack of sufficient financial stimuli, supporting the activity in this respect at the level of self-governing bodies may lead to a lack f perspectives for development of compostable materials [1, 5, 8]

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