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MODULAR PRODUCTION SYSTEM OF PACKAGING OF SRP TYPE – TESTING OF PACKAGING IN DIFFERENT CONDITIONS. PART 1. NORMAL TEMPERATURE

MODUŁOWY SYSTEM PRODUKCJI OPAKOWAŃ TYPU SRP – BADANIA OPAKOWAŃ W RÓŻNYCH WARUNKACH. CZĘŚĆ 1 – TEMPERATURA NORMALNA

ABSTRACT: The article presents the results of research on the resistance of packaging to static pressure. The test was carried out on Plaform® trays without a barrier coating and using the UKAPhob HR 530 barrier at a normal temperature, assuming a wide range of humidity. In order to determine the effect of the increased cardboard humidity on the value of resistance to static pressure, the tests were carried out after air-conditioning of the packaging in six different climatic conditions.
Key words: packaging boards, variants of research on the resistance to static pressure

STRESZCZENIE: W artykule zaprezentowano wyniki badań odporności opakowań na nacisk statyczny. Badanie przeprowadzono na tacach Plaform® bez powłoki barierowej i przy zastosowaniu bariery UKAPhob HR 530 w temperaturze normalnej, przyjmując przy tym szeroki zakres wilgotności. Dla określenia wpływu zwiększonej wilgotności tektury na wartość odporności na nacisk statyczny, badania wykonano po klimatyzowaniu opakowań w sześciu różnych warunkach klimatycznych.
Słowa kluczowe: tektury pudełkowe, warianty badań odporności na nacisk statyczny

INTRODUCTION

Packaging plays the important role in the economy of each country. Therefore, packaging industry to-day is racing in respect of designing and production of packaging and packaging modules which serve many different functional applications. From among many solutions, we should distinguish Shelf Ready Packaging (SRP). It represents the common present trend in exposure of consumer goods, facilitating reduction of service and logistics costs, with the simultaneous increase in value of the product's presentation [1]. The present study was undertaken with the aim to conduct the tests of packaging, having the application in the market as "ready to be placed on the shelf" (SRP – Shelf Ready Packaging). Their design and production were necessitated by the producers; they resulted from the need to lower the costs of work in trading facilities, reducing the time period, dedicated to arrangement of the products on the shelves, abbreviating the time of identification of the products within the shop and increasing the purchase attractiveness.

The planned cycle of the test of packaging at a normal temperature constitutes the first part of the project, the aim of which is the attempt to minimize the producers' costs of SRP packaging production as not to become a factor, significantly affecting the manufacturing costs.

[1] Modular production system of packaging of SRP type – testing of packaging, the tests were carried out for PROTIM SP Ltd., Poznań

Shelf Ready packaging (SRP) is a very popular group of the so-called packaging ready to be placed on a shelf. It is a sort of grouped packaging which, apart from the transport function, play many other additional functions such as exposure or promotion (advertisement). The discussed packaging simplifies a logistic process – there is no necessity of placing the unitary products on the shelves. The packaging itself may be easily placed on the shop shelf and opened. It facilitates optimization of the current supplementation of the shelves and increases the purchase attractiveness. SRP packaging considers many constructional solutions. They are widely employed as packaging of fast moving consumer goods (FMCG – fast Moving Consumer Goods).

Plaform® pattern was developed by the International Paper more than 30 years ago and now it is the packaging which is most frequently used in transport and exposure of fruits and vegetables. Owing to its construction and speed of folding, it is also the most profitable packaging solution[2]. They bear the overprints with information on product and brand.

Plaform® tray shows the products well and ensures an easy access to them. It allows application of attractive design and overprints, with the promotion of trade mark.

The properties of the discussed trays are as follows:

- good visibility of the exposed products and easy access;
- perfect protection of the products during transport;
- economic solution, serving simultaneously the transport and exposition;
- effectiveness of storage – they may be stored in a flat form before their folding;
- easy and quick folding, manually or mechanically;
- the possibility of placing design and overprints, promoting the trademark of the customer.

Plaform® tray is used in transport and retail sales of food products (RRP), including fruits and vegetables, fish and seafood, poultry and meat; it also employed in far distance exports.

PIC. 1. PACKAGING PLAYS THE IMPORTANT ROLE IN THE ECONOMY OF EACH COUNTRY

Packaging stacked on pallets (palletized) are characterized by one of the basic resistance properties of the packaging used in transport and storage as well as a shop exposition. It is resistance to static pressure. The mentioned property is determined by Box Compression test (BCT).

It is the method for testing the resistance to compression of ready formed box. The mentioned test may be used in evaluation of the properties of a given packaging in respect of its resistance to pressure of a degree of the protection of its contents from the effect of the crushing forces.

The discussed test may be conducted as an individual testing in order to examine the consequences of the pressure or stacking effect (deformation, crushing or breaking) or as a part of complex study, carried out with the aim to determine the resistance of the packaging to the threats, occurring in trade

[2] http://www.internaitonalpaper.com

PIC. 2. PACKAGING INDUSTRY TO-DAY IS RACING IN RESPECT OF DESIGNING AND PRODUCTION OF PACKAGING AND PACKAGING MODULES WHICH SERVE MANY DIFFERENT FUNCTIONAL APPLICATIONS

turnover where the damages may be caused by the pressure or stacking.

BCT test is a very good method for optimization of packaging costs. It has been revealed that the boxes made of the same types of paper possess different resistance values. Optimum packaging is such which obtains the required resistance (BCT) at the possibly lowest costs. The technology of paperboard production has a deciding meaning.

Paperboard is the environment-friendly paper material, used in packaging and protection of goods and in production of packaging. We can distinguish solid and corrugated paperboard. The solid paperboards are composed of one or few layers of paper mass, being wet combined during the manufacturing process, without use of adhesive. The corrugated paperboard is a packaging material consisting of alternatively arranges and glued flat and corrugated layers. Depending on the number of layers, we can distinguish single face corrugated board, double faced board, three-, four- layered boards and double wall corrugated board and corrugated seven-layered cardboard. Owing to its properties, the corrugated cardboard is highly appreciated packaging. The layers of the corrugated board affect good shock absorption abilities; due to this fact, the boxes protect sufficiently the packaged products from mechanical damages[3].

The corrugated paperboard is the most frequently employed material in production of packaging. It is manufactured in different varieties and its strength parameters may be shaped within very wide limits. The properties of the corrugated board are dependent, inter alia, on the semi-products and auxiliary materials, employed in its manufacture. Paper is the main raw material used in production of the corrugated cardboard.

The shape and the size of waves is a characteristic feature of the corrugated paperboard. The process of forming the waves and its gluing with flat layers has a basic meaning for the quality of the corrugated paperboard. A high wave causes that the paperboard has better springiness and higher rigidity whereas the paperboard with a lower wave has better resistance to flat crushing what causes a smaller risk of the cardboard puncture. Depending on the dimensions of the wave i.e. height of the wave (distance of the top of the wave from the basement or a distance between two flat layers) and its density, we can distinguish different type of waves[4].

[3] Modular production system of packaging of SRP type – testing of packaging, the test conducted for PROTIM Ltd., Poznań

[4] Korzeniowski A., Commodity science of industrial products, Part III. Testing of the quality of the products, Ed. by AE, Poznań 2006

TAB. 1. CONDITIONING BEFORE THE TESTS: 24 H, TEMPERATURE T 23°C, RELATIVE HUMIDITY RH 50%, BCT TEST WITHOUT BARRIER

No of sample	1	2	3	4	5	Mean
F [kN]	3,5	3,9	3,6	3,9	4,1	3,80

TAB. 2. BCT TEST WITH THE BARRIER

No of sample	1	2	3	4	5	Mean
F [kN]	4,2	4,6	4,7	4,2	4,9	4,52

TAB. 3. CONDITIONING BEFORE THE TESTS: 24 H, TEMPERATURE T 23°C, RELATIVE HUMIDITY RH 60%, BCT TEST WITHOUT BARRIER

No of sample	1	2	3	4	5	Mean
F [kN]	4,1	4,1	4,3	4,3	4,2	4,20

TAB. 4. BCT TEST WITH THE BARRIER

No of sample	1	2	3	4	5	Mean
F [kN]	4,3	4,5	4,2	4,1	4,8	4,38

TAB. 5. CONDITIONING BEFORE THE TESTS: 24 H, TEMPERATURE T 23°C, RELATIVE HUMIDITY RH 70%, BCT TEST WITHOUT BARRIER

No of sample	1	2	3	4	5	Mean
F [kN]	3,9	4,0	3,9	3,9	4,3	4,00

TAB. 6. BCT TEST WITH THE BARRIER

No of sample	1	2	3	4	5	Mean
F [kN]	4,0	4,0	3,9	4,0	3,2	3,96

TAB. 7. CONDITIONING BEFORE THE TESTS: 24 H, TEMPERATURE T 23°C, RELATIVE HUMIDITY RH 80%, BCT TEST WITHOUT THE BARRIER

No of sample	1	2	3	4	5	Mean
F [kN]	3,4	3,5	3,4	3,3	3,0	3,32

TAB. 8. BCT TEST WITH THE BARRIER

No of sample	1	2	3	4	5	Mean
F [kN]	3,7	3,3	3,3	3,4	3,5	3,44

TAB. 9. CONDITIONING BEFORE THE TESTS: 24 H, TEMPERATURE T 23°C, RELATIVE HUMIDITY RH 90%, BCT TEST WITHOUT THE BARRIER

No of sample	1	2	3	4	5	Mean
F [kN]	2,5	2,4	2,4	2,3	2,5	2,42

TAB. 10. BCT TEST WITH THE BARRIER

No of sample	1	2	3	4	5	Mean
F [kN]	2,7	2,5	2,7	2,4	2,6	2,58

TAB. 11. CONDITIONING BEFORE THE TESTS: 24 H, TEMPERATURE T 15°C, RELATIVE HUMIDITY RH 85%, BCT TEST WITHOUT THE BARRIER

No of sample	1	2	3	4	5	Mean
F [kN]	2,7	2,8	3,1	2,9	3,1	2,92

TAB. 12. BCT TEST WITH THE BARRIER

No of sample	1	2	3	4	5	Mean
F [kN]	3,0	3,0	3,1	3,0	3,2	3,06

THE AIM AND THE SCOPE OF THE STUDIES

In the research part of the study, the program of the tests of Plaform® trays made of double wall corrugated board without barrier coating and with the application of UKAPPhob HR 530 barrier, was implemented. Mechanical properties of paper, corrugated paperboard and the performed packaging vary according to the change in the humidity of the ambient air. Therefore, general assumptions of the research work consisted in determination to what degree the conditions of temperature and humidity of conditioning of the paperboard affected its properties and how the characteristics of the paperboard was changing together with the change in the mentioned conditions. The tests of the resistance of the packaging to the static pressure (BCT) by the method specified in standard PN-EN ISO 12048:2002E[5] at a normal temperature, were carried out for six conditions of air-conditioning.

TAB. 13. BCT TEST

	1	2	3	4	5	6
BCT without barrier	3,80	4,20	4,00	3,32	2,42	2,92
BCT with barrier	4,52	4,38	3,96	3,44	2,58	3,06
RH [%]	50	60	70	80	90	85
Temp. [°C]	23	23	23	23	23	15

[5] PN-EN ISO 12048:2002 Packaging – Complete, filled transport packages – Compression and stacking tests using a compression tester

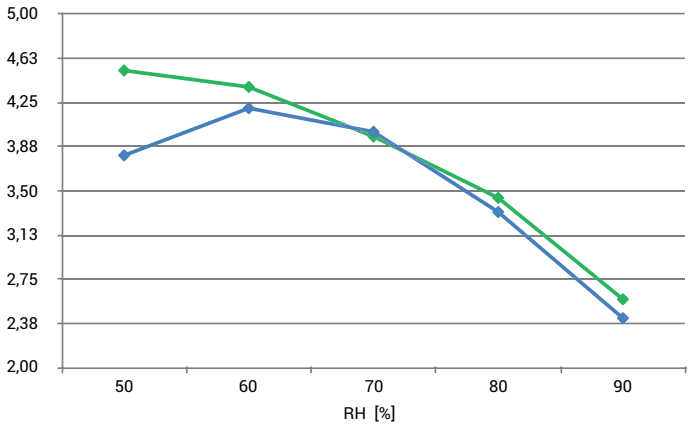

FIG. 1. THE OBTAINED VALUES OF DETERMINATIONS WERE GIVEN IN LINEAR DIAGRAM, ILLUSTRATING THE RELATION OF BCT VALUE DEPENDING ON DIFFERENT CONDITIONING VARIANTS.

PREPARATION OF THE SAMPLES

For the tests, the packages conditioned according to criteria adopted for Stage 1 – Preparation of the samples at a normal temperature, were used.

There were carried out 5 determinations for each Plaform® tray without barrier coating and with the application of UKAPPhob HR 530 barrier, successively for six climatic conditions.

THE RESULTS OF DETERMINATION

The test of boxes' resistance to static pressure were conducted without the contents, until loss of rigidity of packaging, with the registration of the level of compressing force at this moment, expressed in kN. The test of the resistance to pressure determines the resistance of the package to compression. It is expressed by the value of force, acting directly on the box during its compression, causing its destruction or deformation.

The tests of the boxes' resistance to pressure were carried out using Lorentzen& Wettre press type CT 100 with mechanical drive. The mentioned press consists of two rigid flat plates. The upper plate is a mobile compressing plate. The maximum force of the pressure by the described equipment is equal to 100 kN. The rate of the press move during the test amounted to 5 mm/min.

THE RESULTS OF THE TESTS

The results of the conducted tests have been given in tables and in diagrams, representing the range of the values of the examined parameters.

The tables show the results of the test of resistance to a static pressure (BCT, compression test) at a normal temperature, successively for six conditioning variants for packaging – Plaform® tray made of paperboard without barrier coating and with the application of the mentioned barrier.

SUMMING UP

In Stage 1 – Testing of packaging at a normal temperature, the determinations have been carried out and the results for Plaform® tray packaging made of paperboard without barrier coating and with the application of the mentioned barrier, successively for six climatic conditions have been submitted. The obtained values of determinations were given in the tables, showing the mean results for the selected climatic conditions. The analysis of the results of the obtained values of resistance to a static pressure (BCT, compression test) for Plaform® tray packaging indicates that the most favourable results were obtained for paperboard packaging with the application of barrier at the temperature of 23°C and relative humidity (RH) 50%. Under the successively increased humidity conditions, BCT values were distinctly dropping for the paperboard without the barrier as well as with its application; the paperboard with the barrier revealed better properties.

The obtained values of determinations were given in linear diagram, illustrating the relation of BCT value depending on different conditioning variants.

The analysis of the results of Stage 1 allows the conclusion that the conditions of packaging conditioning at various values of relative humidity affected significantly the results of determinations of the performed tests, both for packaging and paperboards without the coating and with its application.

When comparing the results for the selected conditioning variants and their mean values, certain regularities were recorded. The results of BCT determination for Plaform® tray packaging are most favourable for the conditions T=23°C and RH = 50% for the packaging without coating as well as in the case of its application. Throughout the whole cycle of the test with the successive use of all conditioning variants, the more favourable results were decidedly obtained for the packaging with the barrier.

The above fact indicates that the circumstances of conditioning the paperboard have the effect on the results of the conducted tests. Higher values of relative humidity have a negative impact on BCT test, decreasing the resistance properties of paperboard.

When analysing the obtained results of the performed determinations, we may observe that the highest differences were recorded in the comparison of the results obtained for the lowest and the highest conditions of relative humidity. <<

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