

Significant Quality Parameters of Finishing Technology in Offset Printing on Solid Board Boxes Depending on the type of Material

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Abstract

The research in the field of solid board boxes will be focused on defined the significant quality parameters of the refinement of printing according to the type of raw material used in the process. Products that do not meet the quality requirements harm the interests of the company and above all are dangerous for the consumer. The result may be loss of trust from the side of customers, spoiled reputation and costly withdraw from the market all the final defective products. Detecting defects at an early stage of the process can have a positive impact on production schedules and avoid unnecessary additional costs. To packaging requirements belongs: quality, logistic, economic, promotional and environmental requirements. Quality parameters are determined by the actual state of the enterprise, its surroundings and many other factors such as: the feature of raw materials and the applied printing processes, the way of storage, transport. Described and evaluated will be parameters such as functional characteristics of the final product, features complementary to basic, reliability, practicality, conformity with standards (standards concerning packaging, quality of packaging, biodegradable packaging, act of 11.05.2001 on packaging and packaging waste), product durability, aesthetics. The experimental procedure used in the research will be spot score of qualitative characteristics of the different type of raw materials such as: GD (recycled cardboard), GC1 (coated cardboard with white bottom), GC2 (coated cardboard with cream bottom). In the work, printing processes of the printing refinement such as varnishing, hot stamping, cold stamping, embossing, die-cutting, folding and gluing will also be indicated in order to characterize the most important attribute of packaging, packaging design form, packaging functions, classification of packaging regarding to the criteria which are necessary to examine quality parameters. The conclusion of the research will be the comparison of significant quality parameters on different types of refined packages on different raw material used for production. Copyright © VBRI Press.

Keywords: Solid board, packaging, quality parameters.

Introduction

Packaging is known as an article to protect the product against its damage and harmful effects from external factors. It also protects from the environment against the harmful effects of the packaged product as defined by Anna Daszkiewicz, Barbara Dobiegała-Korony [5]. The packaging pays attention and very often prompts customers to buy chosen product. The packaging market in Poland will grow for almost 40% until 2020 as a result of growing expenses on consumption, lifestyle changes as well as export. Referring to the Equity Advisors report, paper with a 25% share is in the

second place immediately after plastic packaging. Most of the processes in printing industry tries to be fully automated. It is difficult make it to quality assessment and control. It is presented developments in the field computational intelligence, creating practical tools to automate the processes of quality [1]. Recent references about the quality parameters are mentioned in a study which said that it is necessary to utilize measurements methods that are based on reliable measurement devices [2]. The packaging industry in Poland has been consolidating strongly in recent years, the example of

one company (American Fund) which has taken over 4 major Polish companies from the packaging industry over the past 3 years: two producers of solid and corrugated board boxes in the north and west of the country, a producer of plastic and solid board boxes and advertising materials in eastern Poland and a part of shares from the company producing comprehensive labels as well as laminated tubes. It is currently the largest printing house with a wide print profile in the whole country. The latest research presents system for measuring and exploring print quality attributes [3]. Raw materials used in the production of solid board packaging belong to the following groups: GC, GD, GT. Cellulose raw materials of cardboard made from primary fibers: GC and recycled GD. Recycled cardboard (GD) - often are used for the production of packaging in which the internal side does not play the main role; used for the production of loose foods like rice, groats and in the automotive, textile and lighting industries.

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Types of cardboard

GC raw materials: GC1 Arktika- cardboard with a white bottom, double-side coated for double-side printing, GC2 Alaska Plus - a cardboard with a cream bottom, one-side coated, mainly for one-side printing. Both cardboards Alaska Plus and Arktika are produced in the factory called International Paper in the production plant in Kwidzys, Poland which is the world's leading packaging board manufacturer. The data about specification of cardboard is taken from the producer company. The basis weight of these raw materials (g / m^2 is the weight of 1 m^2 of cardboard expressed in grams) occur from 190-350 and depending on the application, weight and feature of the final product which is packed in the appropriate packaging with the right basis weight. Alaska Plus is used in packaging of chocolate and confectionery, tea packaging, body care products, pharmaceutical and medical products and hair dyeing products. The selection of raw materials is related to the use of packaging, storage and transport. However, Arktika raw

material is used in perfume, chocolate and confectionery packaging, pharmaceutical packaging and book covers. The technical parameters of raw materials such as stiffness or thickness are important for settings of the packaging machines and cannot be different from each other in deliveries of subsequent batches of packaging. For example, a low basis weight of Alaska Plus raw material is used ($205, 220 \text{ g} / \text{m}^2$) for the production of boxes for tea which are light. When it comes to the production of the chocolate boxes Arktika raw material is used because it is often both-side printing and a weight of $275\text{-}300\text{g} / \text{m}^2$ due to the fact that the chocolate boxes are often additionally protected by heat-shrinkable foil therefore the construction must be rigid. Additionally, it is important to design a packaging with the right fiber raw material which affects to the quality of gluing and packing in the printing house. Raw materials are usually delivered in sheets of two general sizes. The standard dimension is 1000×700 with B1 format and 1400×1000 with B0 format. The second figures 700 and 1000 indicates the running fiber in the raw material. Cardboard stiffness in the direction perpendicular to the fibers running direction is at least twice as large. Carton and paper are used because of the ease and good quality of printing. Carton as a packaging most often is not directly in contact with the product, it can be easily transported.

Printing processes

Products in carton boxes are easier to place on store shelves, can be printed a lot of information on them, essential logos (use the appropriate font and color to contain the most important information), necessary bar codes which are checked at the printing stage in the printing house to avoid return from the market. In addition, the offset printing method is a very good quality method with the print on the highest level and millions of packaging printed in one pass are not different from each other and can be placed side by side on the shelf without color difference. Moreover, print repeatability is much simpler due to the fact that the print parameters are saved in the memory of the printing machine. For the protection the paint is always covered by varnish. It may be a dispersion varnish, a UV- varnish or applying UV varnish and hybrid varnish altogether. Paint varnishes are often used selectively, e.g. UV varnish for better refinement, then it is necessary to use a polymer. The following refinements include cold stamping or hot foil stamping (usually the effect of gold or silver flat or convex embossing on the packaging). Die-cutting of packaging on die cutting machines. These can be machines where tooling (die-cut) with separation is used, usually for very large quantities of ordered boxes or with a complicated shape. From the carton sheet the machine cuts the shape of the packaging depending on the quantity of flat construction on the sheet. The finished die-cut shape of the packaging passes into the PET window gluing or

gluing process. It does not need to require these processes and when is already glued and flat goes to the manufacturer where the product is packed and glued at the same process. Solid board must be suitable for die-cutting, notching, perforation and have a white color on the external surface on which the paint is applied. Printed board must be clean, smooth and have adequate humidity and come from a reliable source. According to Krystyna Lisiecka in order to the assurance of an appropriate level of quality certificates may be use [9]. Certificates used mostly in packaging companies are: ISEGA Certificate (for EU countries) permitting contact with dry and fatty food; Robinson test certificate for fragrance neutrality (the Robinson test is usually carried out also by producers at printing house laboratory and also food manufacturers); FSC certificate, confirming that the wood from which the product was made comes from forests certified in the FSC system. Certificates and quality systems are usually introduced due to the growing demands of customers. The certified management systems include: PN-EN ISO 9001: 2008 Quality Management System, BS EN ISO 15593: 2008 Hygiene Management System in the production of packaging for food products, BRC / IOP. The Hygiene Management System Certificate aims to ensure that all relevant hazards associated with packaging hygiene are identified and adequately supervised. The control of threats requiring monitoring is possible by combining the Pre-condition Programs (PRP) and the HACCP Plan [15].

Quality parameters

Quality - why is it important?

As John Ruskin used to say: "Quality is never a coincidence, it is always the result of human effort". Quality is the state of awareness of all participants taking part in the process of creating and maintaining an appropriate level of quality is also a key and important role in market competition. Quality according to D.A. Garvin, includes eight features used in further analysis, which are [6]:

- functional features of the product, usefulness
- features that complement the basic functional characteristics of the product
- reliability, ability to work trouble-free for a specified period of time
- practicality, defining the adaptability of the product, its ease of use and maintenance
- compliance with the requirements, degree of compliance with previously established standards
- durability, the ability to use the product at a specified working time, treated as a measure of life expectancy
- aesthetics, product appearance, taste, smell, reception and touch

Below in the table a summary of quality parameters together with elements defining the functions of packaging:

The quality parameter	Elements defining the functions of packaging
Functional features of the final product	The shape of the packaging Capacity
Additional features	Graphics (deviation of color from the pattern) Information on the packaging Odorlessness Impact on the price
Reliability	Size difference Packaging palletization Measuring thickness/ basis weight Effective protection of the product
Practical sense	Easy opening/ closing Type of closure Quantity deviation of packaging produced Easy folding after opening Can be used again Easy to get rid of the packaging
Compliance with standards	Ecological aspect The raw material weight deviates from the standards The storage conditions Bar codes (location, correctness) Information on the packaging
Durability	Stiffness of the raw material Resistance to crushing, picking Moisture of the packaging
Aesthetics	Print quality, refining, die-cutting, gluing

For the assessment of selected quality parameters depending on the raw material used, a five-point scale is used. It includes five levels of quality in which:

- Note 5 - means a very good implementation of the assessed function of the packaging,
- Note 4 - means a good implementation of the assessed function of the packaging,
- Note 3 - means sufficient performance of the assessed function of the packaging,
- Note 2 - means insufficient implementation of the assessed function of the packaging,
- Note 1 - means poor performance of the assessed function of the packaging.

The results of the function evaluation are presented in the table depending on the used type of raw material:

Type of raw material	The quality parameter analyzed	Factor of importance	Points	Rate
GC	Functional features of the final product	0,2	5	1
	Additional features	0,1	5	0,5
	Reliability	0,1	4	0,4
	Practical sense	0,2	5	1
	Compliance with standards	0,1	5	0,5
	Durability	0,2	5	1
	Aesthetics	0,1	5	0,5
				4,9
GD	Functional features of the final product	0,2	4	0,8
	Additional features	0,1	4	0,4
	Reliability	0,1	3	0,3
	Practical sense	0,2	3	0,6
	Compliance with standards	0,1	5	0,5
	Durability	0,2	3	0,6
	Aesthetics	0,1	4	0,4
				3,6

To sum up, the rate of quality parameters are higher for cellulose raw materials from the GC group. The raw material used has higher technical feature, is less susceptible for bending, it is easier to print on it and applies all kind of refinements and the packaging looks more aesthetically because of the white or cream-colored bottom not as in the GD raw material. According to Colin F. Hales package functions are divided into: protective, promotional and sales (marketing). The protective function consists: physicochemical features of the packaging. The type of raw material from which the packaging is made as well as intermediate materials to produce the final packaging, i.e. materials for printing: paints, varnishes, foils for PET windows, foil for hot-stamping, coating with polyethylene. It is worth to mention the production processes in the printing house: preparation for printing, so-called Prepress, printing, die cutting, hot or cold stamping, window gluing, gluing, packing, storage. In the prepress process, graphic processing of the files for printing takes place, followed by the print of cromalin which after the client's acceptance is suitable as a color sample-card for printing. Also in this process, the structure of the packaging is checked and if it can be glued during the production process. The promotional and sales function of the packaging includes: providing good protection, promoting and selling the content, enabling the physical marketing of the product,

identifying and distinguishing products. Storage in such way as to take up as little space as possible, it depends on the design and construction of the packaging whether it is a flat folded or glued and packed at the manufacturer place.

Thanks to the fact that packaging industry implements quality management systems and appropriate control and verification systems at each production stage, companies can be sure that the quality of delivered packaging is proper [13].

Packaging differ slightly quite often and it is very difficult to distinguish them at the first glance. Therefore, to prevent the mixing of products, packaging for the pharmaceutical market, labels for canned food, confectionary cartons containing allergens, packaging for light bulbs differing in power, bar code scanner are used on packaging machines [10, 14].

Conclusion and future perspectives

Additionally, the verification of codes in labels and boxes is handled by GS1 Poland which has its headquarter in Poznań. Standards are described on the website: www.gs1.org/standards GS1 also deals with giving of GTIN-13 numbers. GS1 standards are agreed principles and guidelines that are uniformly applied by all entities to improve operations in supply chains in many industries [12].

The packaging have the following functions (component data collected from experience of the author):

- technical functions related to the packaging material used and its construction (package size, tightness, stiffness, type of opening and closing, the way of use, the exposition at the place of sale
- aesthetics (applied printing method, colors, protective varnishes, good quality of packaging in all production processes)
- information functions (information about the product, manufacturer, ingredients, price, etc.)
- protection of the value of the product (protective function: use of the appropriate type of raw material and its basis weight which is important for storage and transport)
- protection of consumer interests (diversification of the size and type of packaging in order to meet different customer needs, ease of use and opening the product: proper perforation, creases, gluing and packaging design for easy opening of the product)
- product promotion (dedicated packaging, promotional graphic design)
- identification and distinguishing the products (product security: hologram ensuring the originality of the product, protection against imitation- automotive industry, a fake directive on pharmaceutical drugs and protection against counterfeits is going to be implemented in Poland in February 2019)
- environmental functions

Solid cardboard packaging is a disposable packaging, often on their surface there are refinements such as UV varnishes, PET foil or laminates. Cellulose or recycled materials are recyclable; requirements regarding the composition of raw materials and the content of harmful and dangerous substances; requirements for multiple use of the packaging; requirements related to recycling of materials. The unit packaging (commercial) is an important factor have an effect on the quality of the wrapped product. It enables delivery, presentation of products, increases their durability, attractiveness, ensures an appropriate level of content quality.

The future of offset printing:

Highly automated systems are big reason that offset printing has become easier. Now is one of the most exciting times that the printing industry has been in a long time. Another paper where print quality parameters result are presented and discussed, examined by measuring various control elements of the printing in order to obtain quantitative information about print standard [4]. Quality is checked at each process of the production by the quality team - samples from each production order are collected, described and tested. At the one of the last process in production of packaging during gluing process quality is provided by machine operators and sometimes detected too late. If it does not apply to comply with the quality guidelines it might be withdrawn - it accrues high costs, financial penalties, loss of trust from the customers [11].

Losses on production at printing companies (downtime of packaging machines are a daily occurrence) and it causes slower packing (use of another raw material, use of raw material with lower basis weight or goods storage in inappropriate conditions- too high humidity, perforations that tear the packaging [7, 8]. Very often the employees of packaging suppliers are rewarded for reporting quality errors on the packaging.

To sum up, the quality parameters depend not only on the quality of the raw materials used but also on the way of storage as well as on certain delivery sources. The raw materials used have the necessary certificates of the product origin control system and meet the applicable legal requirements. The certificates of product origin applied guarantee our clients that the raw materials for packaging production come from responsible forest management and are produced in compliance with ecological and social standards.

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