RESISTANCE OF PAPERBOARD PACKAGING COMPRESSION WITH ADDITION CREASING

Kyzikaitė R., Kabelkaitė-Lukoševičė A.
Kaunas University of Technology

Abstract
Experimental test have been carried with different grammage with additional creasing cardboard packaging during compression. In the experimental test is used three different grammage rectangular paperboard box, specimens. All specimens was supplement with six different type additional creasing. The maximum compression load, that the package can carry paperboard packaging. The effect of paperboard with addition creasing on package resistance to compression was analyzed.
Key words: *packaging, cardboard, creasing, compression*

Introduction

The packaging is the main means of protection, provision of information, and advertising the product. The management of packaging and packaging waste Directive 94/62/EC, which shall comply with the requirements set out in the package. They are subject to additional requirements where the product must be protected to the maximum, without causing side effects to the product inside the package or the user themselves. The requirements of physical properties for the packaging are high. Another very important criteria in the production is the packaging itself and its design. To keep up with the advancing technology and higher requirements, the packaging should be reusable.

Paper (cardboard) waste can be recycled 4 to 6 times. According to the national plan for the management of the municipal waste, the aim for 2014–2020 year is to prepare, reuse and recycle at least 50% of the utilities: paper and cardboard, metal, plastic and glass waste.

The relevance of this theme is based on the management law (directive 94/62/EC) of packaging and packaging waste, which provides that the cardboard/paper packaging must be designed and manufactured in a way that their volume and weight are kept to a minimum.

Experimental

Experimental materials

1. Alaska paperboard was used for testing. It is a high quality, fully coated (the upper side is chalk coated twice), with creamy bottom (GC2) cardboard packaging paper for high quality printing, such as – the pharmaceutical, cosmetic, food and other packaging. It is are strong, stable and rigid.

2. In the experiment I used 230, 250 and 300 grammage cardboard.

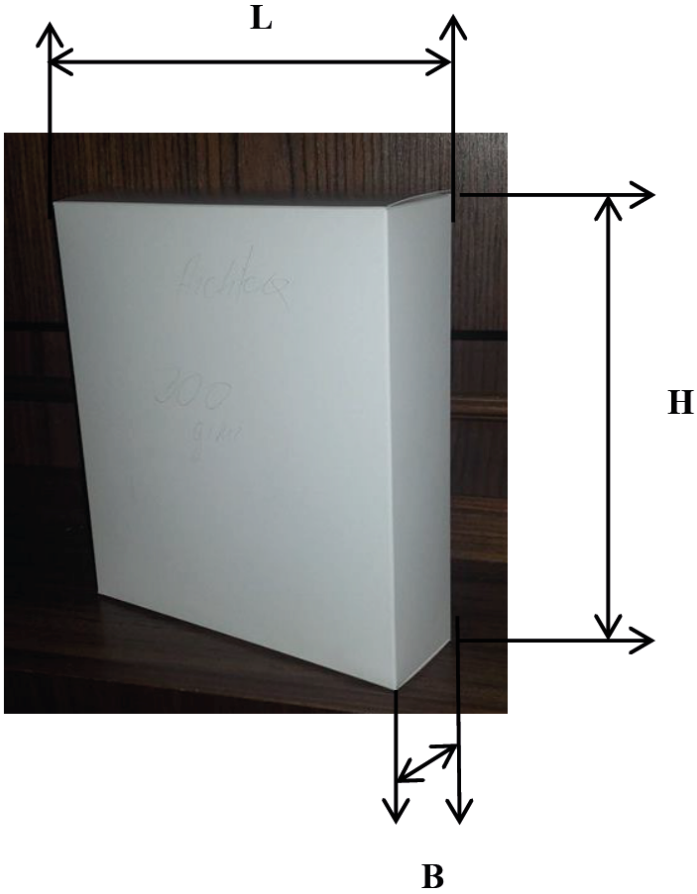

Figure 1 *Specimens (packages): box size (H=200 mm, L=170 mm, B=50 mm)*

3. In this experiment all three different paper thickness were used with an additional bending lines, improving creasing. The additional bending lines placed at the same distance from the border edges were used in all samples. The proportion of all bending pines distance in all three paper thickness were maintained the same. The additional bending lines (creasing) were added on the front and rear sides of the packaging plane. Figure 2 provides a schematic view of additional creasing lines.

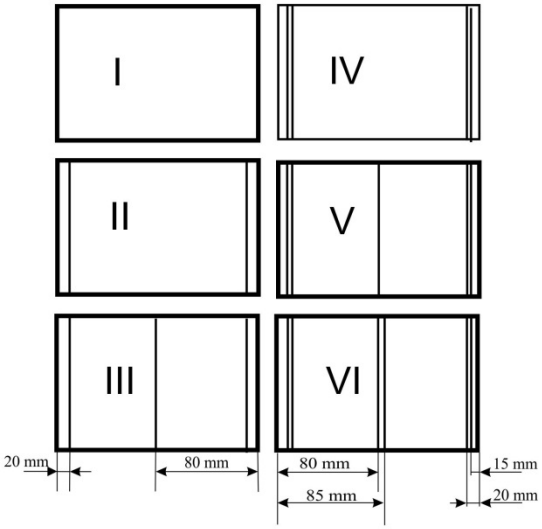

Figure 2. *Additional Creasing*

Experimental instruments

1. Personal computer
2. Tenzometric booster TS-3
3. Box compression stand
4. Software program PicoScope

Results and discussion

Three different 230 g/m^2, and 250 g/m^2 300 g/m^2 thickness paper were used in a six types based on different number of additional lines used: none, four, six, ten or twelve. The package resistance to the deformation was tested with a static load on a wrist principle. The results show data for vertical compressive loads. All of the experimental studies have been used for at

least 4 times. You can see the Results for Vertical compressive load in the figures bellow.

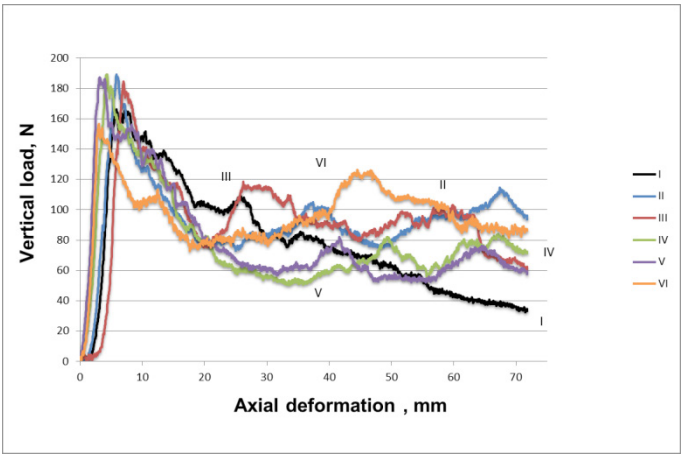

Figure 3 *:230 g/m² diagram*

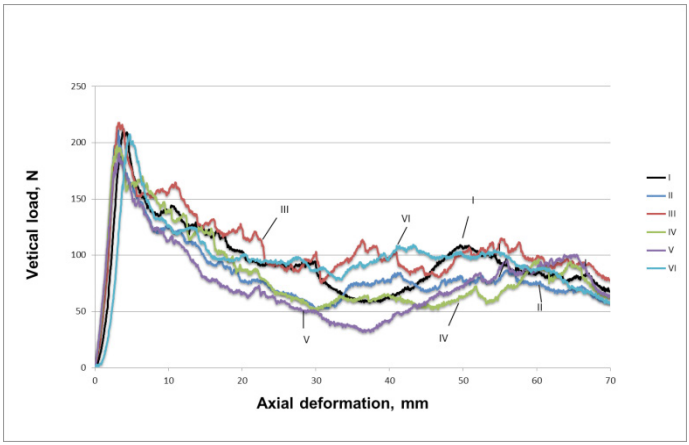

Figure 4 *250 g/m² diagram*

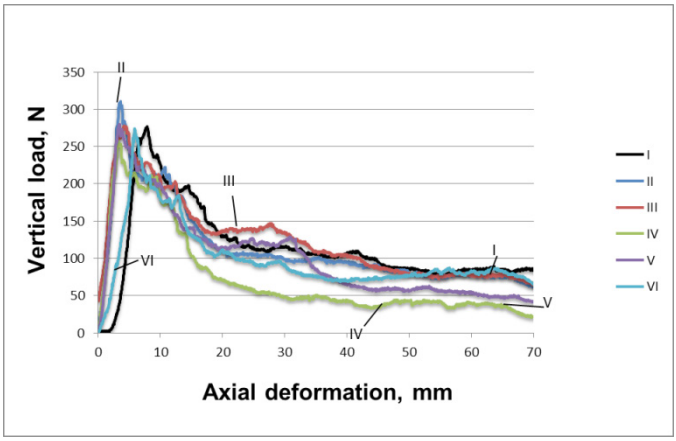

Figure 5 *300 g/m² diagram*

In summary of the three different paper packages, those which have additional lines had more resistance to the compression. The lines added the creasing strength for packaging. Using the additional bending lines the package receives strength and comfort.

However, the investigation has shown that this does not apply in all cases, and the resistance against crushing is not better. The type VI package, in all three different thicknesses, could hold only the minimum force. It is clear that the 12 additional lines weakened the mechanical resistance. We selected II, III and IV package types, which had 4 and 6 additional lines. The maximum deformation force was reached using 300 g/m² package – 6.8 mm. this result is 51% higher when comparing with 250 g/m² III package type and 25% when compared with 230 g/m² II and IV types. In order to use the least possible amount of resource's material, I recommend using the 250 g/m² (III) package type. This type can resist 22 kg compression and deforms only 3.3 mm.

Conclusion

1. The analysis of the results, the effect of an additional creasing lines to the package resistance under compression, shows that 230 g/m² II and III package's types hold 10% higher creasing force, than the type I. Compressive deformation was measured ~ 5 mm.

2. The 250 g/m² package type III shows higher resistance by 3% comparing to package type I with 3.3 mm deformation.

3. The compression resistance analysis of the 300g/m² paper shows that

the package type II has 11% higher resistance force than type I, both were without additional creasing lines. The package deformation was 6.8 mm, which is a 13% lower when comparing with the type I package deformation.

4. Summarizing the results we show that the additional creasing lines improved package mechanical resistance. The tested II, III and IV package types with additional creasing lines improved the compressive force (F_{max}) by 10%, 3% and 11% when used in 230, 250 and 300g/m^2 paper respectively.

5. Fulfilling our aim, to reduce the material resources for packaging, I suggest choosing the 250 g/m2 paperboard. We achieve optimum compression resistance force and deformation when use additional bending lines as it showed in the package type III.

References

1. Cardboard packaging. [Interaktyvus], [Žiūrėta 2017-12-17]: http://pto.lt/
2. The National Waste Management Plan 2014-2016m. [Interaktyvus], [Žiūrėta 2017-01-21]:https://www.e-tar.lt/portal/lt/legalAct/d833b6d-0cfa811e3a8ded1a0f5aff0a9
3. Packaging and Waste Directive. [Interaktyvus], [Žiūrėta 2017-01-21]: http://eur-lex.europa.eu/legal-content/LT/TXT/?uri=CELEX%3A31994L0062
4. Papyrus Lithuania. Arctic. [Interaktyvus], [Žiūrėta 2017-12-17]: https://www.papyrus.com/ltLT/catalog/c/cat2470026/p/prod6170045/Pakavimo_kartonas/Arktika/view.htm?skuId=88025603