

Effect of thermal aging on selected mechanical properties of bplex board

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Abstract: *Effect of thermal aging on selected mechanical properties of bplex board.* The aging process of bplex board made from Kraft type pulp, waste pulp type D (Kraft) and waste pulp type C (white pulp) under the influence of temperature was investigated in this study. After analysing research findings they stated, that the parameters of these cardboards not differ drastically, and what is more they have better aging resistance properties. The exception was the double folding, where the strength decreased by 96-99%.

Keywords: waste pulp, bplex board, mechanical properties

INTRODUCTION

The article is a continuation of the studies described in the article "Effect of Addition of waste pulp on selected mechanical properties of Bplex board" publicized in this magazine and constitutes a piece of the Institute of Chemical Technology of Wood research focused on the use of waste pulp to the production of cardboard and corrugated board. These studies were undertaken due to the current market expectations and continuous search for new, alternative raw materials, simultaneously maintaining adequate strength parameters. The demand for paper is increasing due to the continuous development of civilization. As a result, the search for new, more efficient solutions related to the recovery of paper and its reprocessing. Current technologies of waste pulp paper production provide obtaining a paper featuring a strength comparable to that one manufactured from virgin pulp (Oldham 2006).

Worldwide paper production is still increasing. Since the beginning of the twentieth century steadily doubled in 18 year periods (Wysocka-Robak et al. 2011).

In 2009, the world consumption of cardboard amounted to 370.8 million tons, giving an average per capita of about 54.1 kg per year. In the world total paper usage, the most paper and paperboard, was used in Asia - 43.8%, followed by North America - 21.1%, and European countries belonging to CEPI - 21.9% (Fornalski 2011).

In this article we demonstrate changes in the strength properties of double-layer cardboard subjected to artificial aging process in elevated temperature.

MATERIALS AND METHODS

Materials. The study used three kinds of laminated bplex board produced in the following combinations:

- paper made from Kraft type pulp + Kraft- type paper,
- paper made from Kraft type pulp + waste pulp paper Kraft - type D,
- paper made from Kraft type pulp + white waste pulp paper type C.

Cardboard was made in the laboratory using the Rapid – Köthen device. Weights were ground using a grinder Jokro. degree of beating of the masses determined by Schopper-Riegler apparatus. In the case of Kraft pulp reached $20 \pm 2^\circ\text{SR}$ and recycled pulp ground to $30 \pm 2^\circ\text{SR}$. Obtained sheets of cardboard were prepared for further testing by cutting one sample sizes specified in the standards for individual determinations.

Methods. Prepared cardboard samples were referenced below:

- weight according to PN-EN ISO 536:2011,
- breaking length and extensibility according to PN-EN ISO 1924-2:2010,
- tearing resistance according to EN ISO 1974:2012,
- burst test according to BS EN ISO 2758:2005,
- number of double folding according to ISO 5626:1995,
- air permeability according to ISO 11004:1995,
- thermal aging according to PN-P-50174-01:1993.

RESEARCH RESULTS

The study was based on two of the four types of waste pulp paper according to the European nomenclature, namely types C and D. The choice of masses was dictated by the fact that these two types are the most commonly recovered waste paper and re-processed; moreover they have the highest strength parameters. Table 1 summarizes the average results of the strength properties of bplex board before and after artificial aging. The results demonstrate that the reduction depends on the properties.

Table 1 Comparison of average strength properties of bplex board.

Properties	Research material					
	Board: Kraft/Kraft		Board: Kraft/waste pulp paper type C		Board: Kraft/waste pulp paper type D	
	Before aging	After aging	Before aging	After aging	Before aging	After aging
Breaking length [m]	3650	2980	2905	2418	3400	2698
Extensibility [%]	2,63	1,64	1,16	0,50	1,50	0,98
Burst test [kPa]	1098	989	997	935	1020	967
Double folding	689	7	400	6	465	19
Tearing resistance [mN]	37	9	22	7	30	9
Air permeability [s]	59	51	47	46	52	49

Results shown in Table 1 illustrate the difference between the breaking length before and after aging. This difference amounted to 670 m for board Kraft/Kraft, which is about 18% less. In the case of board Kraft/waste pulp paper type D difference of 720 meters or approx. 21% and for board Kraft/C waste pulp paper that is about 487 m. 17%

The percentage change in the strength properties were collected in Figure 1, Figure 2 and Figure 3 Extensibility decreased the most for board Kraft/waste pulp paper type C and the least for Kraft/waste pulp paper type D. Results of burst test oscillated in the range 90 - 95% of baseline. The most deteriorated number of double folding of cardboard. These parameters decreased almost about 100%. Changes in tear resistance were also significant and concluded in the range 24 - 32% of the initial values.

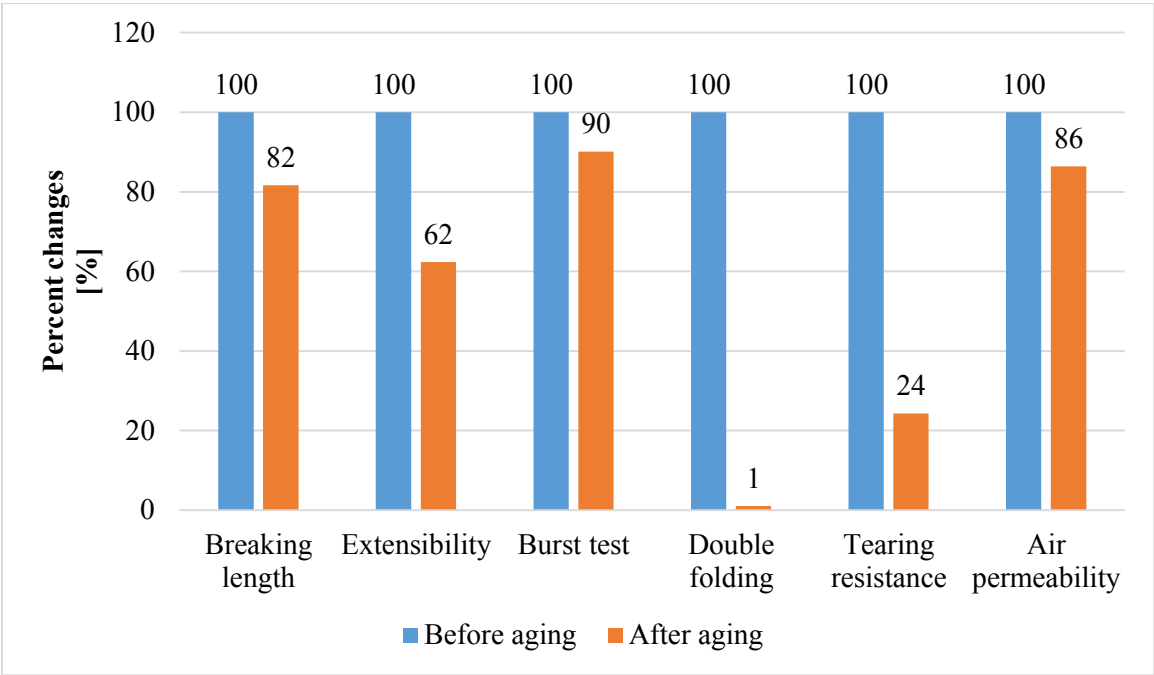


Figure 1 Percentage summary of the average results for the strength properties of board Kraft/Kraft.

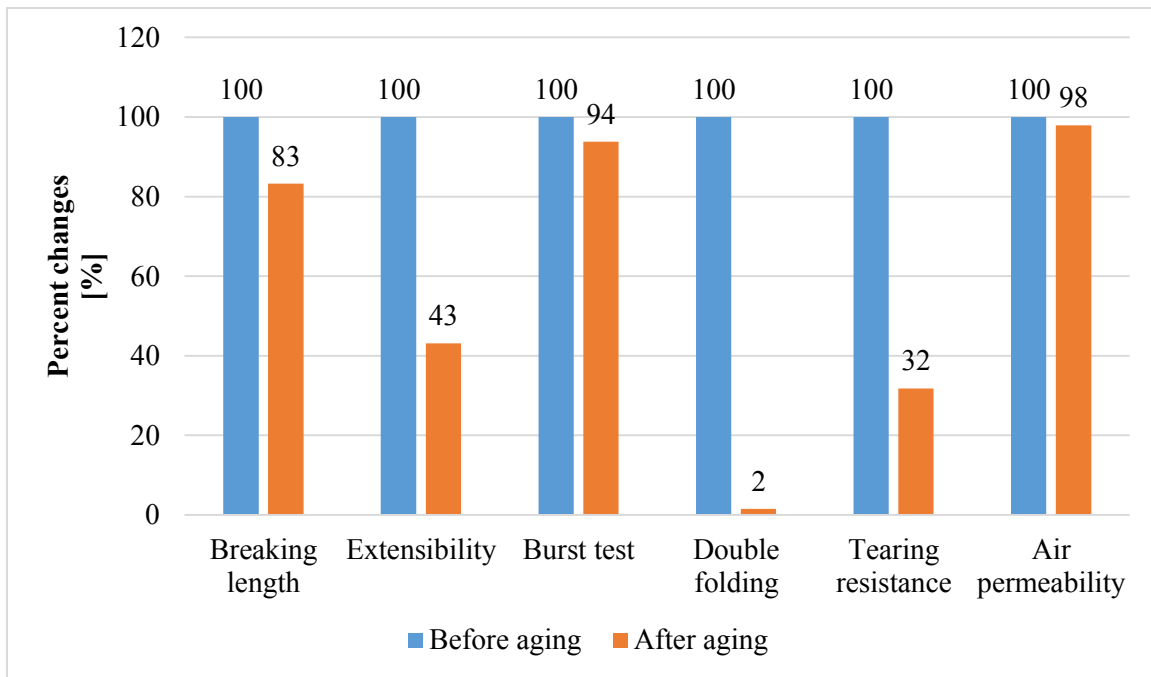


Figure 2 Percentage summary of the average results for the strength properties of board Kraft/waste pulp paper type C.

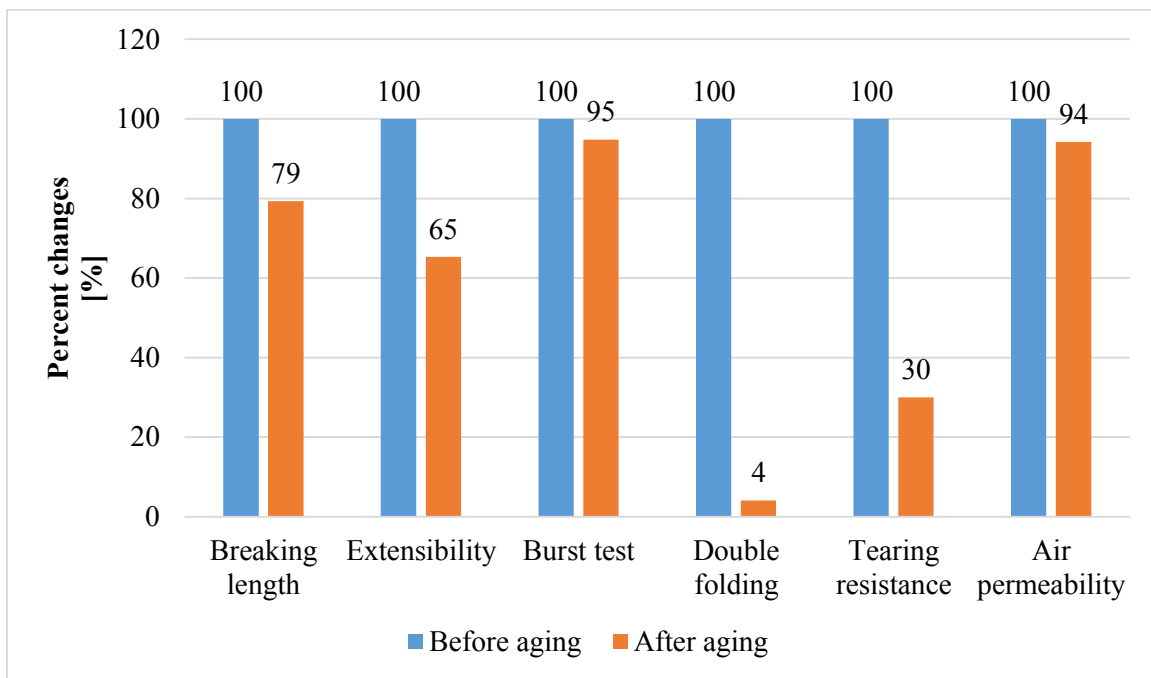


Figure 3 Percentage summary of the average results for the strength properties of board Kraft/waste pulp paper type D.

CONCLUSIONS

Based on this study it can be concluded that, among all the double-layer cardboard the highest strength values were reached for cardboard Kraft/Kraft, both before and after aging.

In terms of breaking length, tear resistance and air permeability, the most resistant to aging turned out to be cardboard, Kraft/waste pulp paper type C. In the case of extensibility, bursting and number of double folding most resistant to aging is bplex board Kraft/waste pulp paper Kraft type D.

Based on this studies it can be concluded that the best bplex board for solid packaging is cardboard Kraft/Kraft, which could have been foreseen before measurements. It should be noted that in the majority of parameters Kraft cardboard/waste pulp paper Kraft type D not lagged significantly from cardboard Kraft/Kraft. An additional advantage of these cardboard was high resistance to aging.

In the era of saving raw material and production costs, performance of bplex board using one layer derived from recycled materials is a very good idea. As in the present study showed the parameters of these cardboards not differ drastically, and what is more they have better aging resistance properties.

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Streszczenie: *Wpływ starzenia termicznego na wybrane właściwości mechaniczne tektury dwuwarstwowej.* W tym artykule badano proces starzenia tektury dwuwarstwowej wytworzonej z masy Kraft, makulatury typu D (Kraft) oraz makulatury typu C (makulatura biurowa) pod wpływem temperatury. Po analizie wyników badań stwierdzono, że parametry tych tektur nie różnią się drastycznie, a co więcej mają lepsze właściwości odporności na starzenie. Wyjątek stanowiło podwójne zginanie, gdzie wytrzymałość spadła o 96-99%.

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