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Addition of allantoin to the water dispersive varnish for cardboard packaging

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Introduction

Regardless of the grim predictions, the graphic industry is still growing industry. The industry's growth is dominantly due to the packaging industry, which in the period of 2023 – 2028 has predicted annual growth of 4% (Metsa board, n.d.). Even more, due to the environmental concerns and regulations (EU Commission, 2018) about plastics, paper and paper-based materials are more present in the packaging industry.
There are various methods to make packaging more attractive, consequently more appealing to customers. One of those methods is coating. Coating makes the packaging surface more appealing by making glossy or matte effect, can be spot applied or covering the whole image. Beside visual infuence on the printed image on packaging, coating is also used to protect the printed image from mechanical or chemical damages caused by exposure of packaging to light, moisture, rubbing, etc. The coating should not influence the visual message of the packaging design, but studies have confirmed that there is change of the reproduction of color due to different types of coatings (Cigula et al., 2022).
To make functional coatings, which will provide even more positives for the basic material, some additional compounds are mixed into the basic coating. In this case it is important to include compounds which will not influence the health and environmental standards of packaging, or to impact on the recycling and/or biodegradation potential of the packaging after use. For that purpose, using compounds of natural origin is of interest to researchers and producers (Fierascu et al., 2021). Having that in mind, the goal of this research is to investigate influence of allantoin onto prints coated with the mixture of commercial water dispersive varnish and various weight ratios of allantoin.
Allantoin is a compound which has origin in plants and animals and is often used in various skincare products (Martin, 2022). This compound has moistu izing effect onto skin and therefore has the potential in keeping moisture in paper and paper-based products. Moisture in paper has significant role in keeping its flexibility (Alava & Niskanen, 2006), enabling cardboard packaging formation and keeping its shape on store shelf.

Methods

For the purpose of this research samples of gloss coated cardboard with grammage of 305 gm-2 (UPM Finesse white gloss) were printed on a four-color offset printing press (KBA Rapida 105). Printing inks used for printing were standard process offset printing ink Novavit Supreme Bio (Flintgroup). To enable color change detection, patches with different tone values from 0 – 100% percent with the step of 10% were de- fined and placed on the test print
The coatings were prepared by dispersing allantoin particles in a commercial water dispersive varnish (Terra High Gloss Coating G9/285 by Actega). Four coatings were prepared by altering added allantoin amount to achieve weight ratio of 0, 0.25, 0.5 and 1%. The coatings were prepared by mixing water dispersive varnish with allantoin for 15 minutes by magnetic stirrer at room temperature and 1000 rpm at room temperature.
Coating of the prepared prints was performed by K control coater, model 202 with the use of coating rod Nr. 3 – defined wet film thickness of 24 µm (RK Printcoat instruments, n.d.). After coating process, samples were left air dry. In the end the samples were exposed to thermal accelerated ageing for 72 hours at 105 oC in a Memmert UNB400 oven. Accelerated thermal ageing is often used to simulate paper ageing and detect changes due to degradation (Małachowska et al., 2021).
The prepared samples were characterized by determining CIE L*a*b* color coordinates and calculating color change ΔEab (Mokrzycki & Tatol, 2011). For the color measurements spectrophotometer SpectroDens (Techkon) was used. Mechanical characterization of samples was performed by measuring bursting strength - Mullen test (measuring unit Lorentzen & Wettre Bursting Strength Tester SE 181) and bending stiffness according to Taber (measuring unit Lorentzen & Wettre bending tester, code 160). All measurements were performed at standard room conditions.

Results

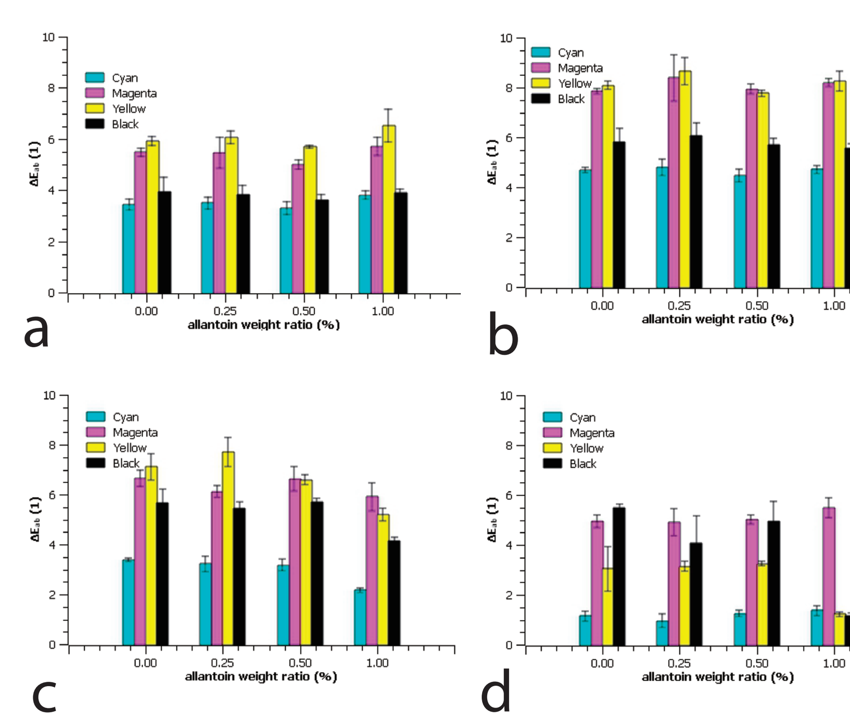

Figure 1.

Color difference on coated samples at: a) low tone value (20%), b) middle tone value (50%), c) high tone value (80%) and d) full tone

It is visible that coating process has the lowest influence on full tone of process colors while the highest color differences are in the middle tone value (Figure 1). there is no influence of the allantoin weight ratio in prepared coating to the resulting color difference.

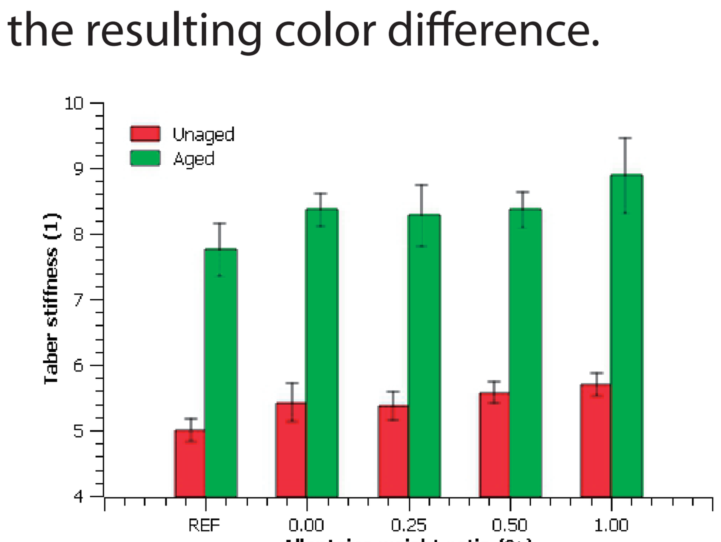

Figure 2.

Taber stiffness of samples before and after accelerated thermal ageing.

One can see that coating process is leading to small increase of Taber stiffness, which further increases with the increase of the allantoin weight ratio (Figure 2). After the accelerated thermal ageing all samples, including the uncoated one (REF) have increased stiffness with keeping the same trend, i.e. the sample coated with the highest allantoin weight ratio having the highest Taber stiffness.

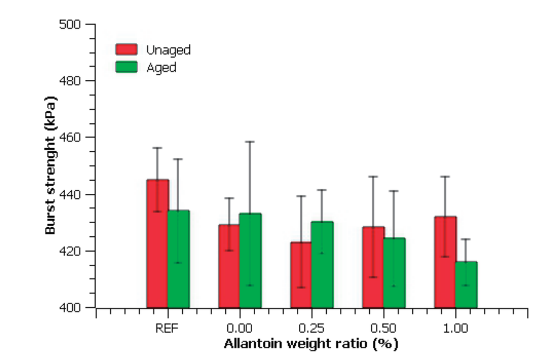

Figure 3

Burst strength of samples before and after accelerated thermal ageing

Bursting strength of samples (Figure 3) decreases with the application of coating on the surface of the print. Nevertheless, the addition of allantoin in the water dispersive varnish does not influence the burst strength. Opposite to the stiffness of the samples, accelerated thermal ageing causes decrease of the burst strength. Although standard deviations of measurements are relatively high, it could be noted that increase of the allantoin weight ratio will lead to the decrease of the burst strength after accelerated thermal ageing.

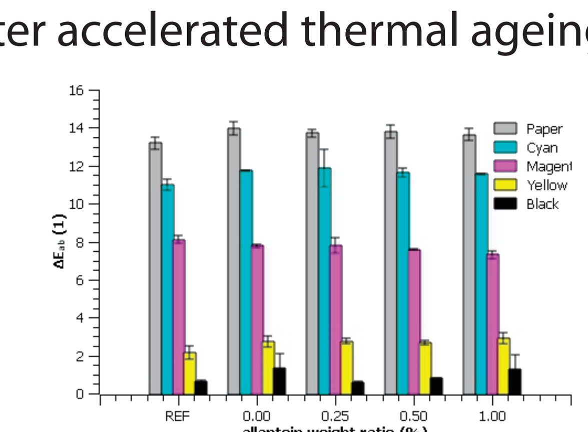

Figure 4

Color difference of paper and full tone on coated samples after accelerated thermal ageing

The highest color change is on the paper and the lowest in black. The results also showed that applied coatings did not influence color change on samples after accelerated thermal ageing.
The color change of tone values aligned to the behavior shown in Figure 4, i.e. the difference was higher in lower tone values (less surface of the paper is covered by printing ink) and lower in higher tone values.

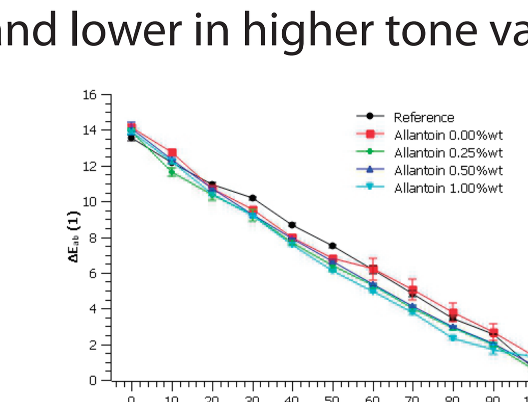

Figure 5

Black color difference after accelerated thermal ageing depending on nominal tone value

Conclusion

This research was conducted to determine the influence of allantoin addition on the protective properties of water dispersive varnish applied on cardboard prints.
Results of this research showed that the application of coatings including allantoin do not significantly influence cardboard prints, but at the same time do not provide protection in the accelerated thermal ageing. It could be concluded that including allantoin in the water dispersive varnish and applying it as an overprint varnish on the cardboard print will not provide higher protection of prints compared to the one without allantoin.

ACKNOWLEDGMENTS

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