

Postupak ocjene doktorskog rada

DOKTORAND/ICA:	Valentina Radić Seleš, mag. ing. techn. graph.
NASLOV RADA na hrv. jeziku:	Racionalna iskoristivost ekološki prihvatljivijih sirovina radi izrade grafičkih proizvoda s fleksografskom tehnikom tiska
NASLOV RADA na engl. jeziku:	Racional utilization of more environmentally acceptable raw materials for production of graphic products with flexographic printing technique

SAŽETAK:

U skladu sa sintagmom „održivi razvoj”, istraživanja u ovom doktorskome radu usmjerena su na dobivanje najznačajnijih kvalitativnih parametara novoga grafičkog proizvoda, izrađenog korištenjem obnovljivih resursa koji odgovaraju standardu grafičkih proizvoda otisnutih fleksografskom tehnikom tiska. Kvalitativna ispitivanja su provedena na fleksografskim otiscima dobivenim s konvencionalnim bojama na bazi vode i modernim bojama koje se suše UV zračenjem. Otisci su tiskani na laboratorijski izrađenim papirnim podlogama koje u različitim omjerima sadrže celuloznu pulpu slame triju vrsta žitarica: pšenice, ječma i pšenoraži te recikliranog papira. Istraživanje je podijeljeno na nekoliko faza: kvalitativnu evaluaciju otiska, stabilnost otiska nakon standardnih metoda ispitivanja pri povišenoj temperaturi i UV svjetlosti, te djelovanje pritiska i različitih kemijskih agensa. Cilj ovog rada je definirati uporabljivost otisaka dobivenih fleksografskom tehnikom tiska na papirnim tiskovnim podlogama s alternativnim nedrvnim vlakancima. Na temelju provedenih istraživanja može se zaključiti kako laboratorijski proizvedeni papiri s dodatkom pulpe slame svih žitarica postižu zadovoljavajuću kvalitetu reprodukcije, pri čemu laboratorijski papiri otisnuti konvencionalnim bojama na bazi vode uglavnom pokazuju izvrsnu optičku stabilnost nakon izlaganja povišenoj temperaturi, kemijskim agensima i pritisku, dok laboratorijski papiri otisnuti UV sušećim fleksografskim bojama najveću otpornost pokazuju prema djelovanju pritiska. Preporuka je da se papiri iz celulozne pulpe navedenih ekološki prihvatljivijih sirovina izrade veće gramature kako bi se postigle manje vrijednosti Euklidske razlike podtona i penetracije boje unutar tiskovne podloge te da se uvedu završne faze površinske obrade papira. Također, na temelju kvalitativnih analiza može se dati preporuka da se papiri s dodatkom pulpe slame žitarica otisnuti konvencionalnim bojama na bazi vode trebaju izbjegavati samo kod ambalaže proizvoda koji sadrže alkalne proizvode ili ulja. Papiri s dodatkom pulpe slame žitarica nisu prikladni za otiskivanje primarne prehrambene ambalaže UV bojama, no zbog svoje izuzetne mehaničke otpornosti mogu se koristiti za tisak raznih publikacija, sekundarne ambalaže i etiketa.

Ključne riječi: fleksografski tisak, nedrvna vlakanca, kvalitativni parametri, inovativne tiskarske podloge, fleksografske boje.

EXTENDED ABSTRACT:

In accordance with the term „sustainable development”, the research in this doctoral thesis is focused on obtaining the most important qualitative parameters of a new graphic product made by using renewable resources, which correspond to the standard of graphic products printed by flexographic printing technique. Qualitative tests were carried out on flexographic prints obtained with conventional water based inks and modern UV curing inks. The prints were made on laboratory-made paper substrates containing cellulose pulp of straw of three types of cereals in different proportions: wheat, barley and triticale, and recycled paper. The study is divided into several phases: the qualitative evaluation of the print, the optical stability of the print after standard methods of testing at high temperature and UV light and the stability on various chemical agents and the pressure. The aim of this study is to define the usability of printing substrates with alternative non wood fibers printed by flexographic printing technique. Based on research, it can be concluded that laboratory-produced papers with the addition of straw pulp of all cereals meet the quality of reproduction, while laboratory papers printed with conventional water-based inks generally show excellent optical stability after exposure to elevated temperature, chemical agents and pressure. Laboratory papers printed with UV flexographic inks show the greatest resistance to pressure. It is recommended that the cellulose pulp papers of these environmentally friendly raw materials be made of higher weight to achieve lower values of Euclidean undertone differences and color penetration within the printing substrate and to introduce the final stages of paper surface treatment. Also, based on qualitative analysis, it can be recommended that papers with the addition of cereal straw pulp printed with conventional water-based paints should be avoided

only when packaging is containing alkaline products or oils. Although papers with the addition of cereal straw pulp are not suitable for printing with UV curing inks for use in primary food packaging, due to their good mechanical resistance they are excellent for printing various publications and labels.

Experimental part was conducted in the following order: Forming of laboratory papers by mixing straw pulp from three types of cereals, wheat, barley and triticale in different mass ratios with the pulp of commercial paper made from recycled wood pulp. The mass ratios for the straw pulp of each type of cereal are: 10% straw pulp and 90% recycled commercial paper pulp, 20% straw pulp and 80% recycled commercial paper pulp and 30% straw pulp and 70% recycled commercial paper pulp. Laboratory papers were then printed on a flexographic printing simulator with two types of ink: conventional water-based and UV ink. All printing substrates are printed with both types of flexographic inks in monochrome (cyan, magenta, yellow, black) and multichrome (yellow + magenta, yellow + cyan, cyan + magenta, yellow + cyan + magenta) prints. Usability of the prints made on paper with addition of straw pulp were observed based on qualitative measurements: spectrophotometric values of color, graininess, mottling, optical density, total amount of color on the print (undertone), trapping and ink penetration within printing substrates. Optical stability of prints was analysed based on elevated temperature and UV light, the effect of various chemical agents and pressure. Changes in the prints were determined based on the colorimetric difference, ie the Euclidean difference in the color of the prints before and after the treatment. Synthesis of results provides insight and guidelines on which laboratory papers are most acceptable for a particular graphic product, taking into account the type of ink.

Based on the qualitative analysis, it can be concluded that satisfactory quality of reproduction of monochromatic and multichromatic colors obtained by flexographic printing technique was achieved on laboratory papers with the addition of wheat, barley and triticale straw pulp. It is recommended that the paper is made of a higher grammage in order to achieve lower values of Euclidean difference of undertones and ink penetration within the printing substrate and to carry out the final stages of paper production.

Flexographic prints on laboratory papers with cereal straw pulp printed with conventional water-based inks have very good optical stability after exposure to elevated temperature and UV radiation for 48 hours. After a period of 96 hours changes that are not optimal show laboratory papers printed with cyan and yellow ink. Also, most laboratory papers printed with conventional water-based inks have optimal chemical stability. Lower optical stability is caused by alkali on all printed substrates, where the most stable laboratory papers are printed in yellow and black inks, while all flexographic prints showed poor resistance to soybean oil. Flexographic prints also showed excellent stability, ie resistance to pressure except laboratory papers printed with three layers of ink.

Laboratory papers with the addition of straw pulp of all cereals are not equally good for printing with UV inks and conventional water-based inks. Both inks used on laboratory papers with the addition of straw pulp of all cereals shows advantages or disadvantages in various situations. It is the same, of course, with commercial papers used in the industry for the production of various graphic products. It is important to plan very well which ink will be printed on which paper in order for the purpose of the final product to be fulfilled. Since most laboratory papers with the addition of wheat, barley and triticale straw pulp printed with conventional water-based inks have good resistance to elevated temperature, chemical agents and pressure, with additional finishing stages and increasing the weight of such newly formed papers with non-wood fibers could be used for various purposes: for a certain type of food packaging that does not contain oils or alkaline products, tobacco packaging, crates, bags, folders, office paper, books and various publications. Laboratory papers with the addition of straw pulp of all cereals printed with UV inks showed the best stability in the case of printing with yellow and black and excellent mechanical stability. Although not recommended for use in primary food packaging, they could be used to print a variety of publications and labels.

Key words: flexographic printing, non-wood fibres, qualitative parameters, innovative printing substrates, flexographic inks

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