THE PENETRATION PROFILES OF INK JET INKS INTO LABORATORY SUBSTRATES WITH BARLEY PULP

PROFILI PENETRACIJE INK JET BOJA U LABORATORIJSKIM LISTOVIMA S PULPOM JEČMA

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SAŽETAK

Povećana svjetska ekološka svijest dovela je do znatnog porasta upotrebe recikliranog papira ili novih alternativnih izvora celuloznih vlakanaca, umjesto drveća, za proizvodnju papira. Kako reciklirana drvna vlakna ne pružaju istu razinu kvalitete papira kao primarna vlakanca, neprestano se traže i istražuju alternativni izvori celuloznih vlakanaca.

U ovom radu promatrani su profili penetracije UV ink jet boja unutar laboratorijskih listova formiranih dodavanjem pulpe ječma u različitim omjerima u pulpu recikliranog papira. Svi dobiveni rezultati uspoređeni su s kontrolnim uzorkom, odnosno laboratorijskim listom, proizvedenim samo od reciklirane papirne pulpe.

Profili penetracije izrađeni su promatranjem i analizom snimljenih mikroskopskih slika presjeka uzorka, koji su prethodno kalupirani u epoksidnoj smoli. Cilj ovog rada je ispitati utjecaj nedrvnih vlakanaca na kvalitetu otiska te predložiti koji je udio takvih vlakanaca najprihvatljiviji za proizvodnju papira.

Ključne riječi: profili penetracije, pulpa ječma, laboratorijski listovi, UV ink jet boje

ABSTRACT

Increased worldwide environmental awareness has led to a substantial increase in the use of recycled papers and new alternative sources of cellulose fibres to manufacture new paper. Recovered wood fibers do not provide the same level of paper quality as the virgin ones, therefore alternative sources of cellulose fibers are continuously sought and researched.

In this paper, the penetration profiles of UV ink jet inks within laboratory substrates formed with the addition of barley pulp in different weight proportions into pulp from recycled paper were observed. All the results have been compared to the control sample, respectively laboratory substrate produced only from recycled paper pulp.

Penetration profiles were performed by observing and analyzing the microscopic images captured in the region of interest from a cross section of a pre-molded specimen into an epoxy resin. The aim of this paper is to examine whether the proportion of non-wood fibers effects the print quality, and to propose which fiber ratio is the most acceptable for paper production.

Keywords: penetration profile, barley pulp, laboratory substrate, UV ink jet inks

EXPERIMENTAL PART

METODOLOGY

In this paper, the penetration profiles of UV ink jet inks into printing substrates made of barley pulp and a control sample made entirely of recycled wood pulp were compared. Laboratory substrates of approx. 42.5 g/m2 formed by Rapid-Köthen sheet former (FRANK-PTI) were made from wood pulp or from mixture of wood and barley pulp (Table 1.). Semichemical barley pulp was obtained from crop residue leftover on a fields after harvesting which was collected, manually cut and processed by soda pulping method.

Table 1: Laboratory papers composition

Laboratory papers		
Mark	Composition	
	Barley pulp (B), %	Recycled pulp (N), %
N	0	100
1NB	10	90
2NB	20	80
3NB	30	70

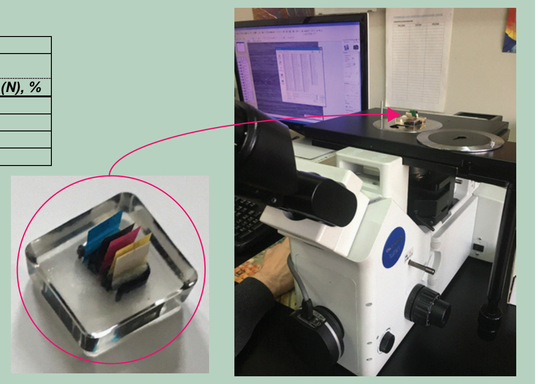


Figure 1. The specimen inserted into an epoxy resin and light microscope Olympus GX 51 analysis of the cross section of samples

On laboratory substrates fulltone areas of cyan, magenta and yellow inks were printed by digital EFI Rastek H652 UV curable ink jet printer with the resolution of 600 × 600 dots per inch (dpi) (respectively with high quality mode 8 pass) and printing speed of 12.10 m2/ hr.

Prints were cut to 10 mm × 30 mm strips which were inserted into an epoxy resin, a mixture of Epofix resin (contains bisphenol-a-diglycidylether) and Epofix hardener (contains triethylenetetramine). The specimens (Figure 1.) were dried at room temperature for 12 hours prior to grinding and polishing which were performed using a Buehler Grinder Machine and Struers DAP-V Polishing Machine.

The cross section of samples was observed at 200× magnification using a light microscope Olympus GX 51 with an Analysis software and captured images in region of interest were further analyzed by ImageJ software to examine penetration of ink jet inks into laboratory substrates with barley pulp.

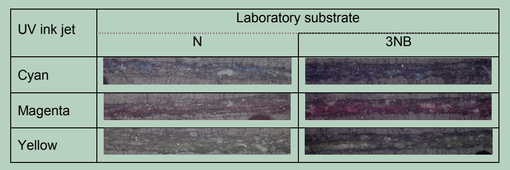


Figure 2. Cross section of laboratory substrates N and 3NB printed with cyan, magenta and yellow ink

RESULTS AND DISCUSSION

Table 2. The thickness of laboratory papers determinate on microscopic images of the cross section of samples

Unprinted laboratory substrate	Thickness (μm)	
	Average	Stdev.
N	81.58	2.39
1NB	68.03	3.33
2NB	84.45	7.38
3NB	83.44	5.55

Printed laboratory substrate	UV ink jet ink	Thickness (μm)	
		Average	Stdev.
N	Cyan	103.15	6.27
	Magenta	94.98	4.76
	Yellow	108.43	5.50
1NB	Cyan	103.15	6.27
	Magenta	99.78	3.92
	Yellow	91.54	5.56
2NB	Cyan	80.57	4.80
	Magenta	82.90	5.76
	Yellow	85.58	5.40
3NB	Cyan	86.09	8.92
	Magenta	83.02	6.06
	Yellow	96.63	4.54

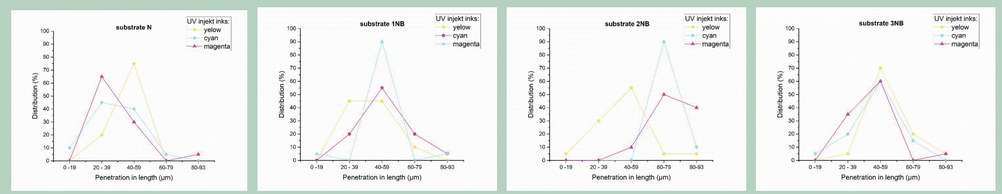
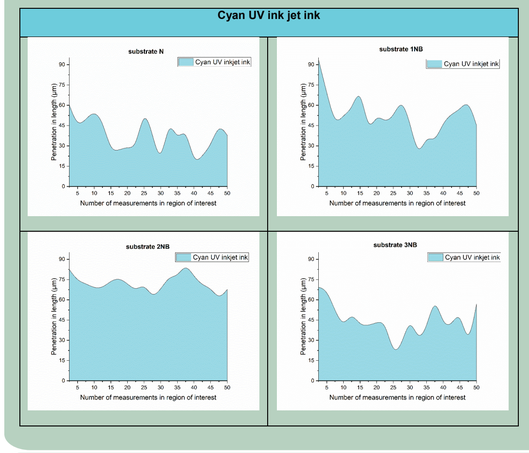
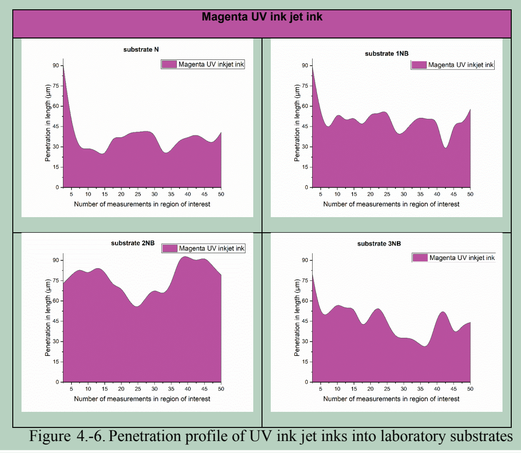


Figure 3. Penetration distributions of UV ink jet inks into laboratory substrates





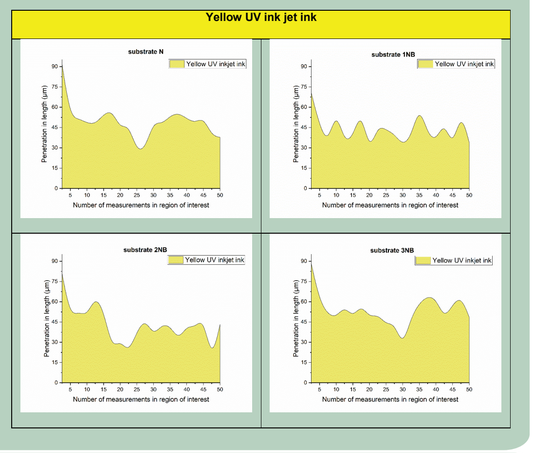


Figure 4.-6. Penetration profile of UV ink jet inks into laboratory substrates

CONCLUSION

From penetration profiles it is visible that all substrates have nonuniform penetration values indicating a very high inhomogeneity of laboratory made substrates. It is clear that the addition of barley pulp increases the penetration of all inks into the substrate by about 10% compared to the substrates without barley pulp. Generally, into laboratory substrates with barely pulp all inks penetrate more than 1/2 of the substrates thickness while for laboratory substrates without barely pulp penetration length is slightly higher than 1/3 of the substrate thickness.

Keeping in mind that virgin fibres provide papers that absorb better than recycled papers and that this research has been done on laboratory made paper that have not gone through the final stages of surface treatment, the obtained ink penetration results are promising for the usage of barley pulp in the manufacture of printing paper.

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