Relation Between the Thickness of Ink Receiving Layer and Color Image Quality, Physical Properties

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Abstract

We made ink receiving emulsion with nano-porosity alumina sol and used modified watersoluble polymer and hydrophilic polymer as a binder. The modified watersoluble polymer was of polyvinylalcohol, hydroxypropylmethylcelluose and the hydrophilic polymer was of polyacrylurea, polyacrylstyrene, polyacrylamide, all added by cation surfactant. With the ink receiving emulsion, we differenciated the thickness of coating in a range of 15~40 μm on the resin coated papers and dry up all of the coating samples. After drying, we printed all the samples on the inkjet color printer and examine the cross section of the image-printed area with microscope to observe how much color image quality such as resolving power, bleeding and physical properties such as lightstability, waterstability, waterfastness, glossiness would be affected by the absorption of ink on every different thickness of coating samples.

Introduction

In this study, we made ink receiving layer with mixing nano porosity alumina sol, water soluble polyvinyl alcohol, hydroxy propyl methyl cellouse and its modified polymer or hydrophilicity of functional groups such as non ion poly acryurea, poly acrylstyrene, polyacrylamide and cation surfactant. After making the emulsion, we coated it on the resin coated paper and printed on color inkjet printer.

We observed improved physical properties[1] of the color printed images on the coated papers such as ink dry time, light stability, water fastness, glossiness, stiffness.

Also, we put 4 kinds of cation surfactants into the inkjet receiving layer nano porosity alumina emulsion to get cation charged emulsion layer on the RC paper.

On this emulsion layer, we found the second alumina particles arranged in a langmuir model and the lateral in a BET model which increased zeta potential and resulted in quick ink absorbing and ink dry time, ultimately improved color printing image quality and physical properties.[2]

In this study, we made ink receiving layer nano porosity alumina emulsion with cation ion surfactants such as dedecyl trimethyl ammonium methyl sulfate (DTAMS).

We coated the alumina emulsion on the RC paper in different thicknesses; 15 μm, 20 μm, 25 μm, 30 μm, 34 μm and printed the papers on cubic chart magenta ink.

We took later-eyed pictures (200 times) on each image by optical microscope in order to study the relation between magenta ink dry absorption and ink solvent absorption.

Also, we printed black on each layer in 0.1 μm line resolving and took pictures (200 times) by optical microscope so as to study what this printing would give to the resolution and what would be the relation between the results of this test and color image quality, physical properties.

Experimental

We made ink receiving nano alumina emulsion by adding surfactant DOTAMS into the formulation in the previous paper 2.

Sample Coating

In coating of ink receiving layer, we selected 270 g poly ethylene coated paper of OJI (Japan). The coater was a slot die coater with 25inch-width and we made the ink receiving layer in thicknesses of 15 μm, 20 μm, 25 μm, 30 μm, 34 μm. We cut the sample paper into the size of 4 × 6” and printed it on Epson stylus photo 1290 a cubic test chart, colors of Y, M, C, B were printed on the paper, and exposed to light stability Xenon acr (420 nm) for 10 hours at 63°C to study color image quality and physical properties. We took later pictures on magenta color by optical microscope and we printed resolve chart on black image to see resolving power. We tested the paper with conditions and equipments as follows

Density Measurement

Photospectrometer (X-light Co.)

Gloss Measurement

Micro Gross Ref-160 (Sheen Co.) at the angles of 85° and 60°.

Water Fastness Test

Immersed the paper into deionized water of 20°C for 3 hours and dried. Photospectrometer (X-light Co.) was used to measure the density.

Results

As it is shown in Figure 1, we could not divide the ink magenta dye layer from ink solvent layer in the thickness of 15 μm. Figure2 shows that a dim separation between the two layers in the thickness of ink receiving layer 20 μm. Meanwhile, Figure 3, 4, and 5 show apparent separation between the two layers in the thickness of 25 μm, 30 μm, 34 μm.

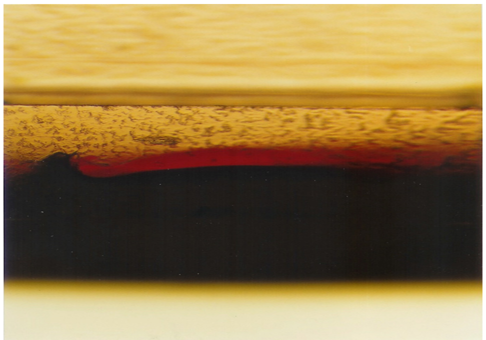

Figure 1. Coating layer thickness 15 μm Magenta ink printing. 200 times optical microscope picture (lateral)

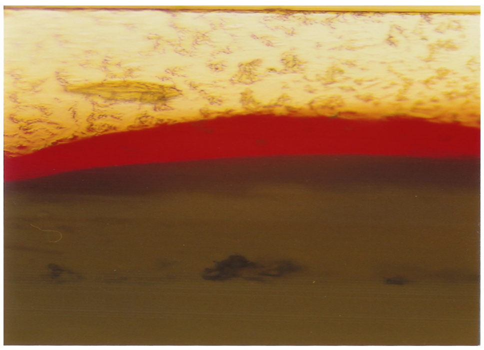

Figure 2. Coating layer thickness 20 μm magenta ink printing 200 times optical microscope picture (lateral)

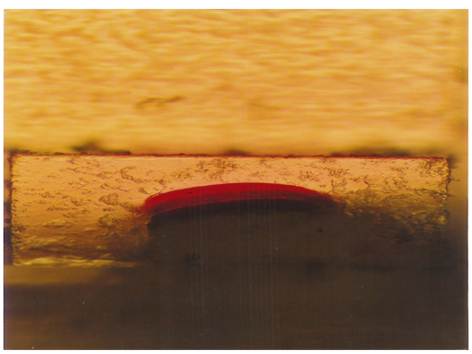

Figure 3. Coating layer thickness 25 μm Magenta ink printing 200 times optical microscope picture (lateral)

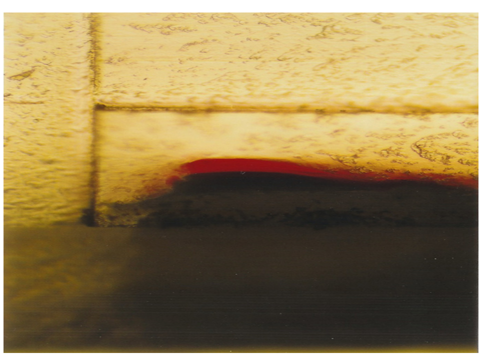

Figure 4. Coating layer thickness 30 μm Magenta ink printing 200 times optical microscope picture (lateral)

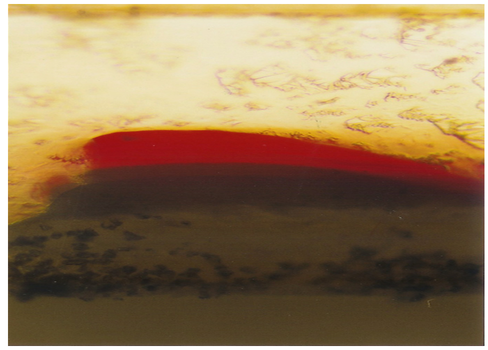

Figure 5. Coating layer thickness 34 μm Magenta ink printing 200 times optical microscope picture (lateral)

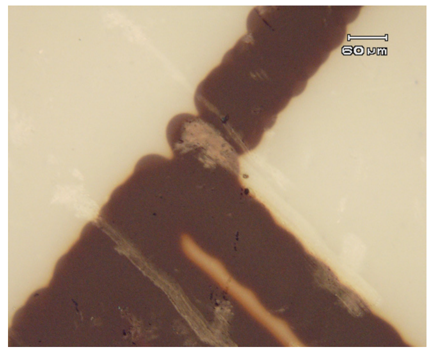

Figure 6. Coating thickness 15 μm (0.1 μm line block printing 200 times optical microscope)

To observe resolution qualities, we printed 0.1 µm black line on the papers of different thicknesses of ink receiving layer and took optical microscope pictures (200 times). Figure 6 shows a diffusion of ink colors between the lines in the layer thickness of 15 µm, meanwhile there is no ink color diffusion between the lines in the layer thickness of 20 µm - 34 µm as shown in the Figures 7, 8, 9, and 10.

Discussion

We coated ink receiving layer on the resin coated paper, ranged from 15 µm - 34 µm, to observe magenta ink printing quality by optical microscope.

As a result, we found that ink dye absorption layer could be told from the ink solved absorption layer, but the image quality was diffused as it shown in Figure 6 in the ink receiving layer thickness 15 µm.

In the thickness of ink receiving layer 20 µm - 34 µm, ink dye absorption layer and ink solvent absorption layer could be separated and there was no diffusion in image quality.

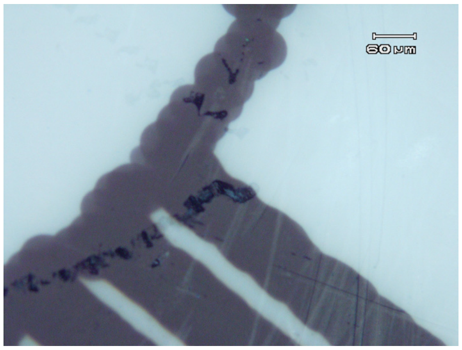

Figure 7. Coating thickness 20 μm (0.1 μm line block printing 200 times optical microscope)

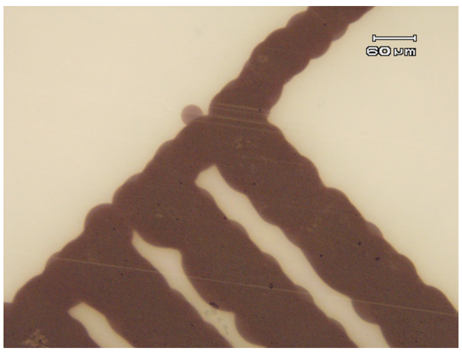

Figure 8. Coating thickness 25 μm (0.1 μm line block printing 200 times optical microscope)

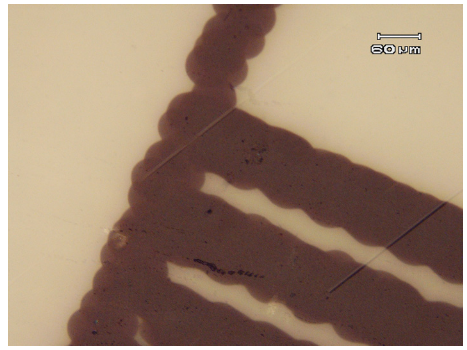

Figure 9. Coating thickness 30 μm (0.1 μm line block printing 200 times optical microscope)

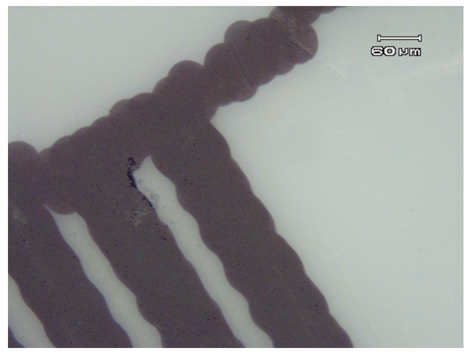

Figure 10. Coating thickness 34 μm (0.1 μm line block printing 200 times optical microscope)

Table 1: Changes in OD and Other Physical Values by UV

Sample			Ink receive layer thickness (μm)				
			15	20	25	30	34
Glossiness	85°		85.90	86.72	88.65	88.78	90.54
	60°		46.52	44.81	47.86	48.35	48.46
Light Stability	Normal	Y	0.75	0.76	0.78	0.80	0.82
		M	1.30	1.40	1.40	1.43	1.44
		C	1.05	1.07	1.09	1.10	1.12
		B	1.48	1.59	1.60	1.61	1.62
	After 10 hours	Y	0.64	0.72	0.78	0.79	0.80
		M	1.20	1.30	1.36	1.39	1.42
		C	0.80	1.02	1.04	1.06	1.09
		B	1.12	1.46	1.58	1.60	1.62
Water Fastness	Decreased (%)		8	6	4	3	3
Drying Time	Sec.		0.2	0.2	0.3	0.3	0.3

As for the resolution, we found ink bleedings from the thicknesses of ink receiving layer 15 μm - 34 μm but this was because we enlarged the optical microscope picture of 0.1 μm resolving line up to 200 times. And it might be related to the capability of ink nozzle. This could be assured by UV test on optical density, as shown in the Figure and it shows generally decreased density of Y, M, C, B in the thickness of 15 μm, 20 μm, 25 μm, but there was no decrease in the thicknesses of 30 μm, 34 μm.

From this study, we found that the thickness of ink receiving layer should make water-fastness, thinner the thickness worse water-fastness and that ink receiving layer would peeled off from the resin coated paper in the thickness of 15 μm.

Conclusion

We took 200 times pictures of optical microscope on magenta ink printings on the different ink receiving layer thickness papers to observe the relation between ink receiving layer and ink dye and ink solvent.

As a result, in ink receiving layer thickness 15 μm, ink dye absorption was not seen separated from ink solvent and in ink receiving layer thickness 20 μm, the separation was seen but bled meanwhile in thickness of 25 μm and 34 μm, the separation was clear.

We found that this result gave affection to the image resolution; in thin ink receiving layer thickness, ink dye and ink solvent went diffused and images were fogged. But in thickness of 25 μm ~ 34 μm, resolving line was seen separated apparently.

From the result, we found that there should be a relation between OD and physical property; thinner thickness of ink receiving layer, worse glossness, light stability, water-fastness, but quicker dry time.

We concluded that between 30 μm and 34 μm of ink receiving layer thickness would be good to get satisfying OD and physical property from inkjet color printing.

References

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