A Particle Size Effect of Pigmented Ink Jet Inks on their Light Stability

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Pigmented Inks – High Stability & Poor Quality

Merits: High image stability

- Light fastness
- Gas fastness
- Water resistance

Demerits: Poor image quality

- Optical density
- Color gamut
- Gloss

⇨ Small sized pigmented inks were investigated to solve the image quality issue.[*1]

[*1] A. D. Bermel and D. E. Bugner, *J. Imaging Sci. Technol.*, **43**, 320 (1999);

Particle Size Effects

1. Small sized pigmented inks can:
   - give higher optical densities.
   - enlarge color gamut.
2. Small sized C&M inks did not fade; particle size did not appear to affect the light stability for C&M.
3. Large & small sized PY74 inks faded significantly.

- Why only yellow pigmented inks faded so significantly?
- Are there any light stable small yellow pigments?

Purpose of this Work

1. To clarify the mechanism of the size effects on the light fading behavior.
2. To discover light stable small-sized yellow pigments.

- Preparation of ink-sets with different sized pigments
- Investigation of their behavior under irradiation

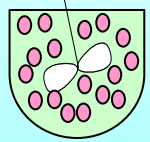
Experimental

Pigments - C: PB15:3

M: PR122

Y: PY74, PY128, PY138

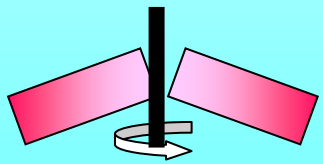
Dispersions - Pigments



milling

"Large" dispersions

"Medium" dispersions



differential centrifugation

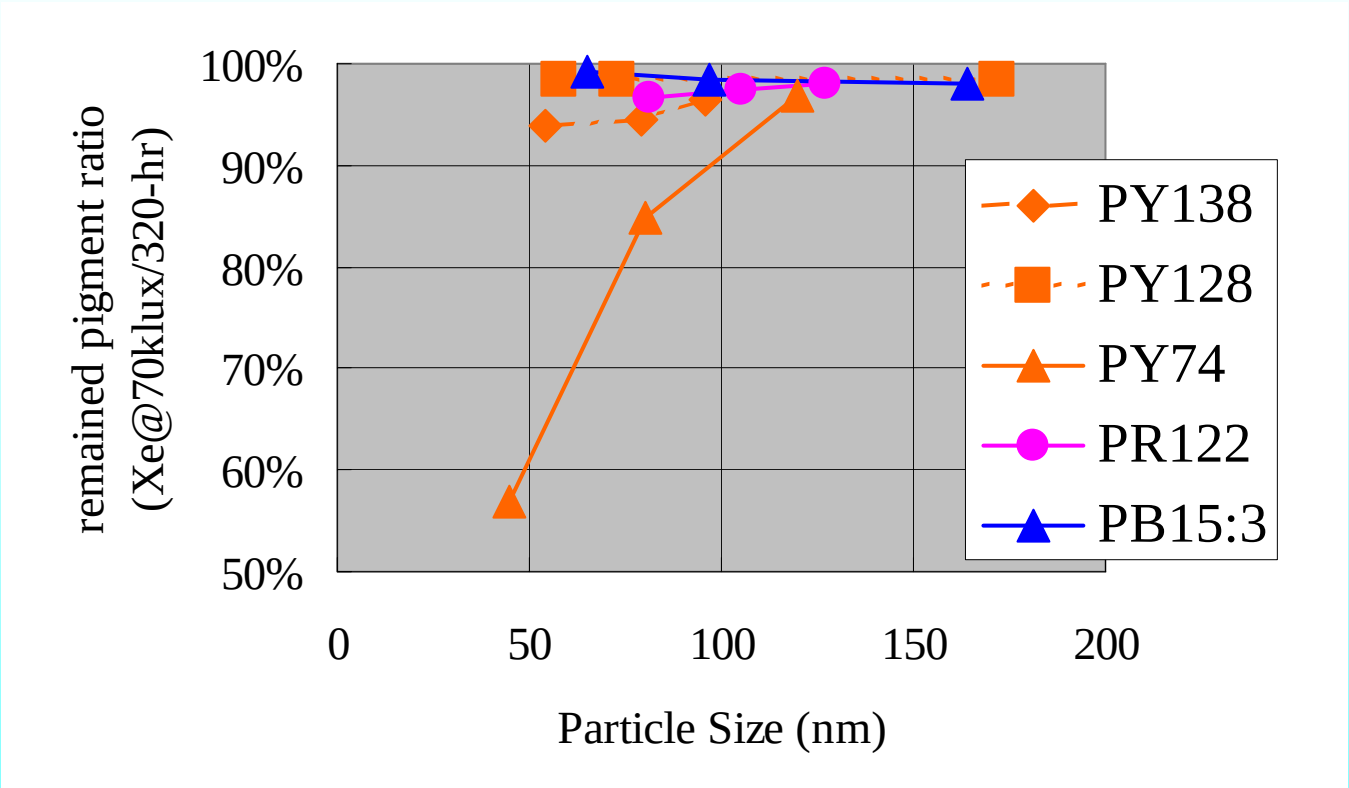
"Small" dispersions

Particle Sizes of Dispersions

Color	Pigment	Particle Size*		
		"Large" disp.	"Medium" disp.	"Small" disp.
Cyan	PB15:3	164	97	65
Magenta	PR122	127	105	81
Yellow	PY138	96	79	54
	PY128	172	73	58
	PY74	120	80	45

* a volume average diameter (nm)

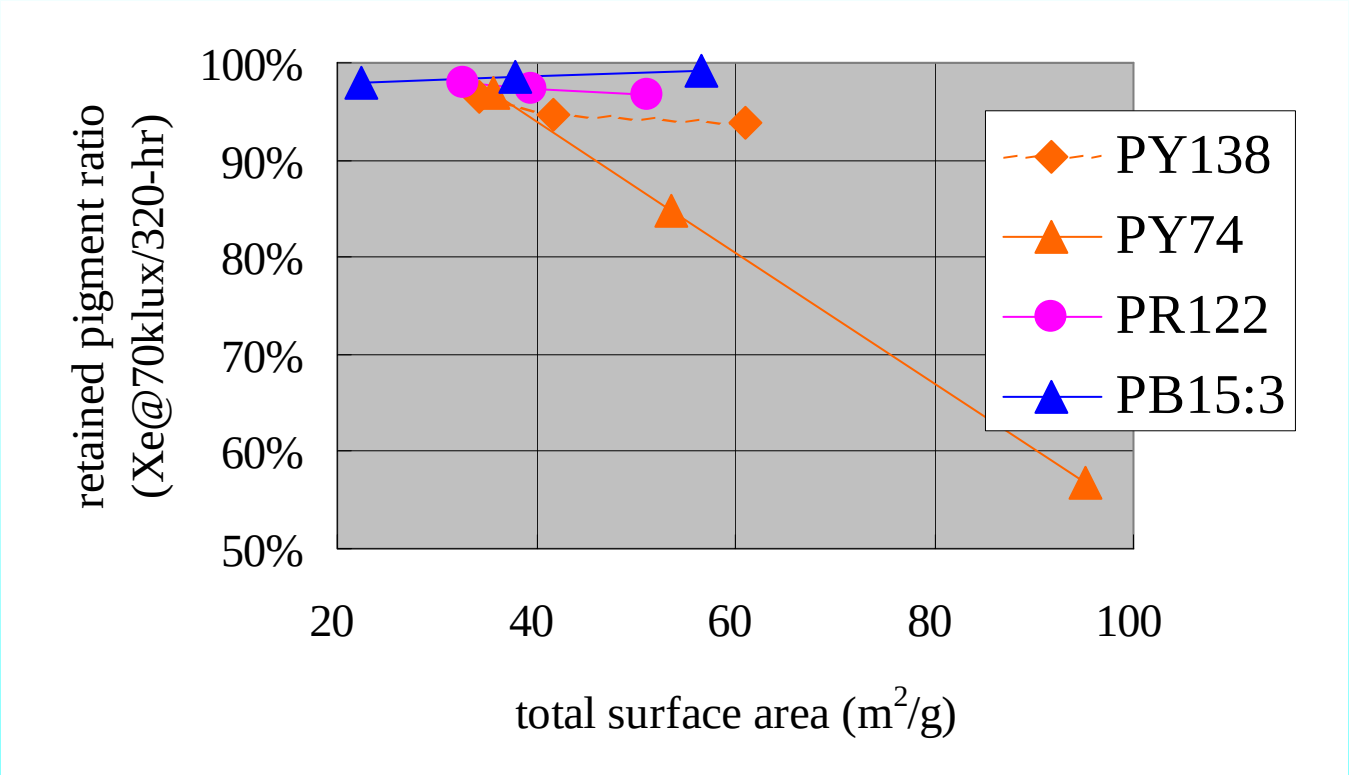
A Size Effect on the Light Fastness



- All PY 128 and PY138 were stable against light.

- PY74 exhibited size dependency on the L.F.

Relationship between Pigment's Surface Area and their Light Fading Behavior



- Linear relationship was observed for PY74.

- PY138 and PR122 seemed to decrease the ratio with the area.

Factor of Light-Fading Reaction

1. Surface area seemed to control the fading behavior of PY74.
2. Stable surface region seemed to be different for every pigments.

Hypothesis:

1. Light stable pigments aggregate or agglomerate on the recording media surface; act likely as larger particles.
2. Chemical structure of pigments control the light-fading reaction.

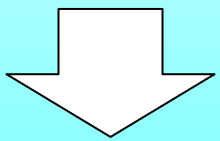
Estimation of Aggregation/Agglomeration

Aggregation/agglomeration will make rough of the print's surface.

*aggregation/agglomeration

= stacking of "large" particles

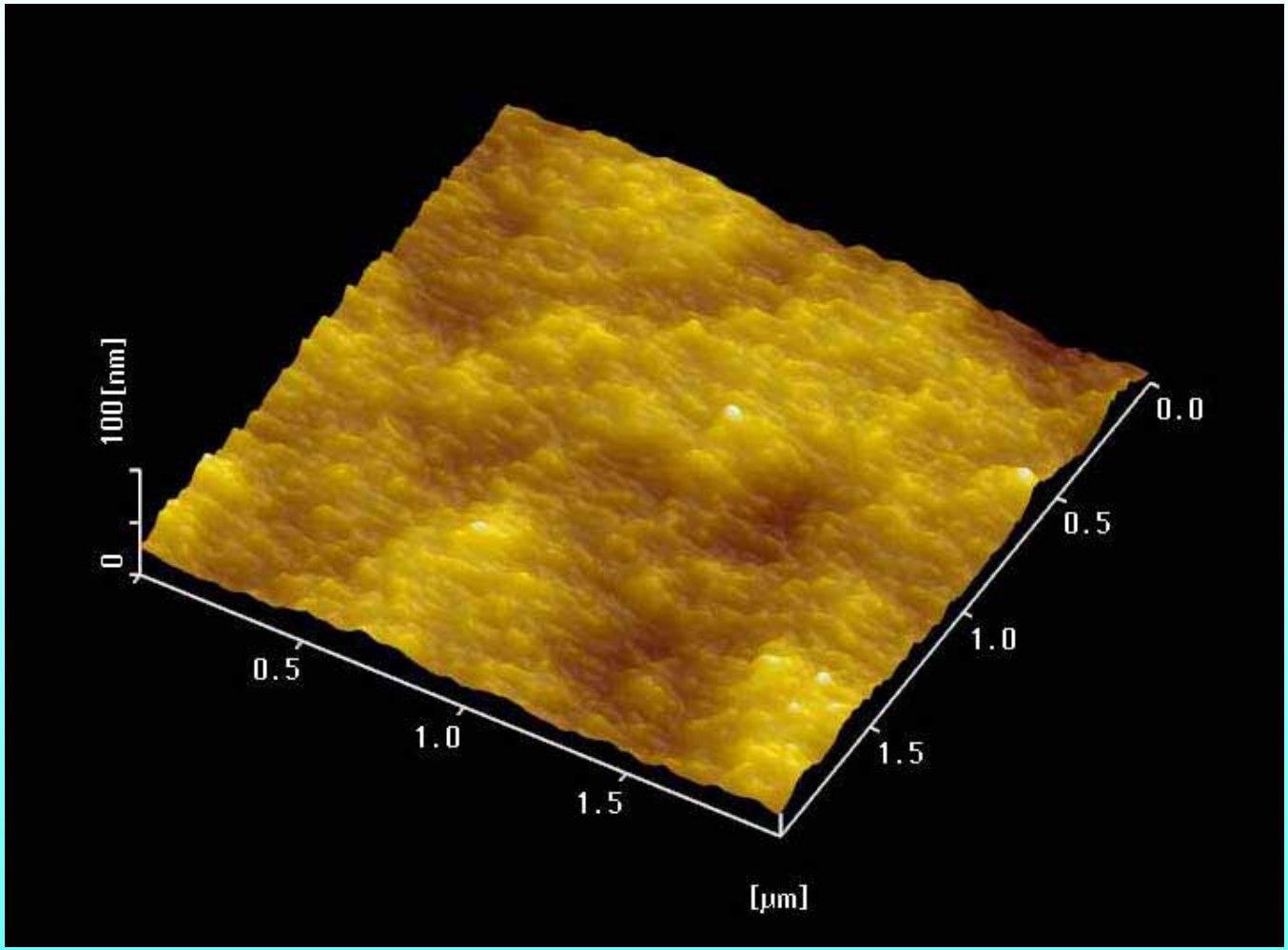
= increase of surface roughness



Surface roughness index: R_{max}

R_{max} = height of the highest peak

An AFM Image of PY47-print's Surface



R_{max} Values of the Images

Color	Pigment	R_{max} "Large" disp.	R_{max} "Medium" disp.	R_{max} "Small" disp.
Cyan	PB15:3	61	21	12
Magenta	PR122	26	18	16
Yellow	PY138	45	29	25
	PY128	65	59	27
	PY74	37	31	11

(nm)

The levels of aggregation/agglomeration were compatible in the same category of dispersions.

⇨ Effects of aggregation/agglomeration were not large.

Conclusion

1. PY74 showed a size dependency; small sized particles faded more rapidly than larger sized particles did. The surface area seemed to control its light-fading behavior.
2. All sizes of PY128 and PY138 have been stable against light; no size dependency was observed.
3. Levels of surface roughness were compatible in the same category of dispersions; effects of aggregation/agglomeration did not seem to be large to control the light fading behavior of pigments.