Effect of Talc on Improvement of Gravure Printability of Coated Paperboard

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ABSTRACT

Talc has been used as coating pigments for gravure printing paper and light weight coated paper (LWC) in Europe for 30 years and the use of talc has been significantly increased every year. Currently, talc is used for about 15% of pigments for paper coating. Especially more than 50% of the coating pigments for gravure printing paper and web printing paper (web off-set) is applying talc. The use of talc improves printability, smoothness, and the coverage of base paper, and showed a significant effect on reducing the coated paper basis weight. In addition, it improves compressibility of the coating layer, influencing the gravure printability.

I. INTRODUCTION

In 1985, Ahone investigated properties of talc utilized for the production of LWC. Talc is hydrophobic and a platelike shape. Talc improves opacity, ink gloss and smoothness while reduces paper gloss. When tested with the IGT printability tester, talc improves surface strength and reduces ink absorption. Also it was reported that talc slightly increases the ink density for web gravure coating, improves brightness, and significantly increases printability.[1)]

Maillard et al. (1999) showed that talc improved ink scuff resistance of matte and semi-matt coating paper without affecting other paper properties. Generally, talc improves surface strength, ink set-off property and SNAP. Talc can also provide a low friction coefficient for the matt coated paper.[2)]

Kim and Lee (1999) investigated the effects of pigment particle size on coated paper properties and pore properties of the coating layer using GCC with various particle sizes. The effect of particle size on the porosity of coating layer was reported.[3)]

Kim and Lee (2001) elucidated the effects of pigment shapes on coated paper properties and pore properties of the coating layer using 4 types of pigments whose particle shapes were different. They reported that smoothness of a coated paper is influenced by the size of the pigments while paper gloss is affected by the shape of the pigments.[4)]

Kim (2002) reported that talc has an influence on the viscosity of coating color together with the binder system. Water retention of talc is lower than that of clay and addition of micropariticle GCC significantly improves water retention. Talc showed improvements in smoothness and printability of the gravure printing paper coating without deteriorating other physical properties such as gloss.[5)]

In 2005, Centa and Sharma reported that the use of talc will be the general trend to improve productivity. Talc is the smoothest among inorganic materials, chemically inert, hydrophobic and has a plate-like shape, whose properties provide opportunities to increase profits in rotogravure and matt off-set printing. Talc reduces paper crepe winkles and sheet break in rotogravure printing, while it reduces paper gloss and ink scuff, increases printing gloss, and provides feeling of silk in matt off-set printing. In barrier coating, talc's platelike shape and hydrophobic increased the barrier properties and, in a label grade, talc improved productivity and reduced downtime.[6)]

II. Materials and Method

2. 1 Materials

2. 1. 1 Pigment

Ground Calcium Carbonate (GCC, OMYA Korea), talc (Cotalc-90, KOCH KOREA), clay (Engelhard, ULTRAGLOSS-LV) were used as coating pigments.

Properties of each pigment are shown in Table 1.

Table 1. Properties of pigment for paper coating

Pigment	Talc 2000	No.1 Clay	GCC 95	GCC 60
Type	Powder	Powder	Slurry	Slurry
Commercial Name	Cotalc-90	ULTRAGLOSS-LV	Setacarb	Hydrocarb
pH	10.3 *1)	10.1*1)	9.44	9.74
Moisture (%)	0.5 ± 0.1	0.5 ± 0.1	-	-
Viscosity(cp)	-	-	340	112
Solids content (%)	-	-	75.17	75.07
Mean Size(㎛)	4.0	1.2	-	-
Brightness	93.12	88.10	91.74	93.09

*1): 65% slurry (D 50)

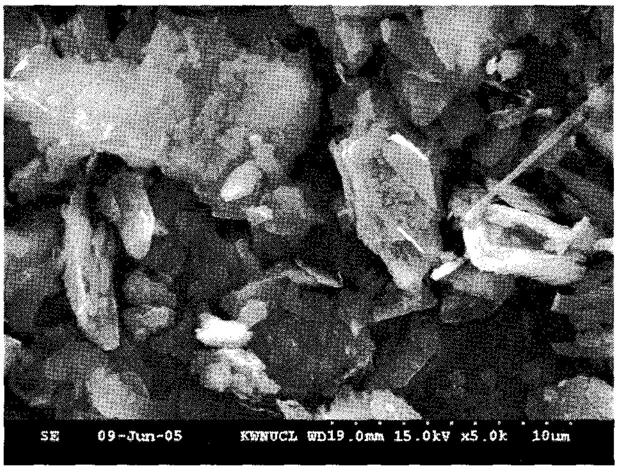

Photo 1. SEM photo of Cotalc-90.

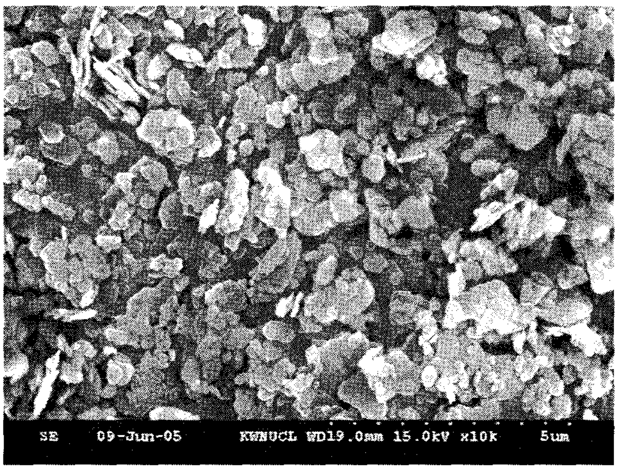

Photo 2. SEM photo of No.1 clay.

2. 1. 2 Binder

S/B latex (LUTEX 701, LG Chemical LTD.) was used and properties of the binder are shown in Table 2.

Table 2. Properties of binders for paper coating

Binder	Type	Solids content (%)	pH
LUTEX 701	Styrene-Butadiene Latex	50.08	8.0

2. 1. 3 Additives

Dispersant (JEONG WEON CHEMICAL Co. Ltd.) was use to uniformly disperse pigments and thickener (JEONG WEON CHEMICAL Co. Ltd.) was used to control viscosity of the coating color. Lubricant (Nopcotec-155) and Insolubilizer were also used. Properties of the additives are shown in Table 3.

Table 3. Properties of Additives for paper coating

Additive	Solids content (%)	Viscosity(cp)	pH
Dispersant	40.97	39	7.34
Lubricant	55.39	37.3	12.41
Thickener	30.36	59	5.56
Insolubilizer	30.01	0.83	7.14

2. 2 Experimental

2. 2. 1 Formulation of coating color

Table 4. Formulation of coating color

		1	2	3	4	5	6	7
Pre	GCC-60	100					100	80
	Talc	-					-	20
	Latex	12.5	12.5	12.5	12.5	12.5	12.5	12.0
	Insolubilizer	0.5						
	Thickener	0.15						
	Solid Content	64						
Top	GCC-95	40	40	50	40	35	40	40
	Clay	60	50	40	40	35	55	50
	Talc	-	10	10	20	30	-	10
	HSP	-	-	-	-	-	5	-
	Latex	12.0	12.0	12.0	11.5	11.0	12.0	12.0
	Lubricant	0.7						
	Insolubilizer	0.6						
	Thickener	0.15						

	Solid Content	66

2. 2. 2 Preparation and testing of coated paper

2. 2. 2. 1 Preparation of coated paper

Single coated paperboards, whose pre and top coating weight was 15 g/m2, were produced by the K-control coater with the coating color prepared according to the formulation shown in Table 4. The coated paperboards were dried for 30 sec. at a drying oven. The coated paperboards were then cut to 18cm×20cm and calendered twice with a laboratory supercalender (Beloit weeler). Temperature of the roll was 70℃ and pressure was 250 phi.

2. 2. 2. 2 Physical Properties of coated paperboard

Roughness, smoothness, porosity and gloss were measured. Smoothness was measured by PPS and gloss was determined with a gloss meter as specified in TAPPI Standard T480 om-92. Air permeability was tested by PPS.

2. 2. 2. 3 Printing

Printing was evaluated in terms of the missing dot after performing Helio test by IGT tester.

III. Results and Discussion

3. 1 Water retention and viscosity of coating color

Water retention was increased with increasing the talc content. This is due to the platelike shape of talc with a high aspect ratio, which results in blocking the flow of water. Viscosity of coating color was decreased with increasing talc concentration. This is because talc with a larger size works as a lubricant between the smaller sized particles (clay and GCC).

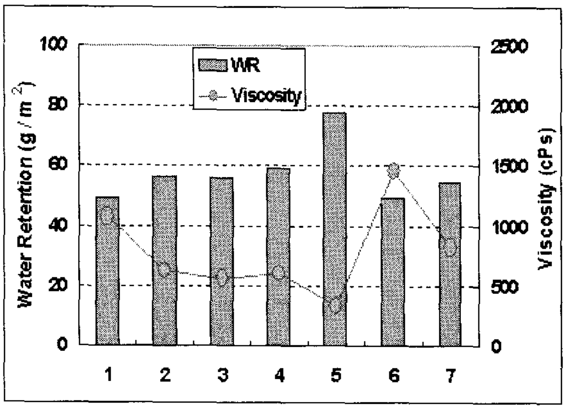

Fig. 1 Water retention and viscosity

3. 2 Roughness and paper gloss of coated board

Roughness of coated board was slightly increased with the addition of talc. This is due to the larger size of talc than clay and GCC. However, the difference was not significant. Best smoothness was shown when hollow sphere pigment (HSP) was used. Gloss of coated board was significantly reduced with increasing talc content. This is due to its inherent property. The highest gloss was observed when HSP was used.

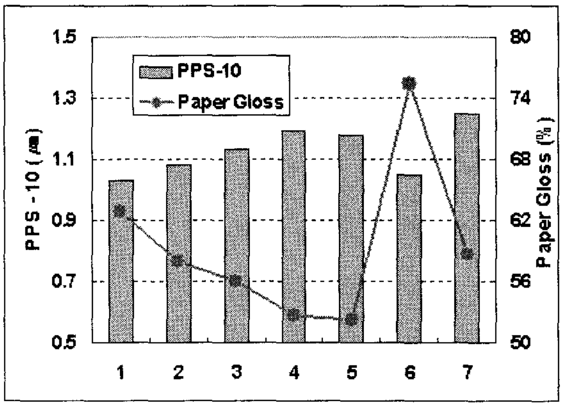

Fig. 2 Roughness and paper gloss

3. 3 Porosity of coated board

Porosity of coated board was slightly increased with increasing talc addition. This is due to the talc's platelike shape with a high aspect ratio, which helps to form a bottle neck pore structure, blocking air flow. The lowest porosity was observed when HSP was used. HSP has a uniform sphere shape and then the pore structure is opened.

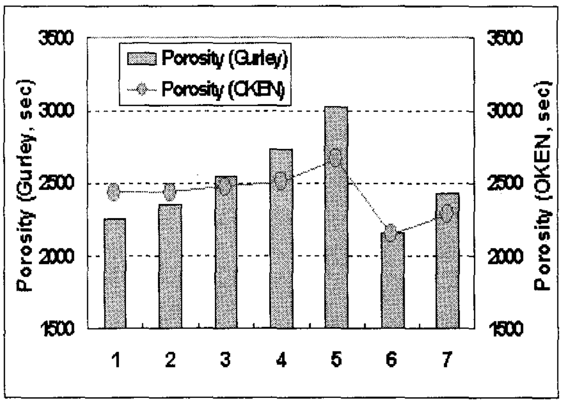

Fig. 3 Porosity (Gurley and OKEN)

3. 4 Missing dot and compressibility

Missing dot and compressibility of coated board was increased with increasing the talc content. This is because talc has a platelike shape with a high aspect ratio and form a larger card house than clay in coating layer, resulting in a higher compressibility during a printing process.[1)]

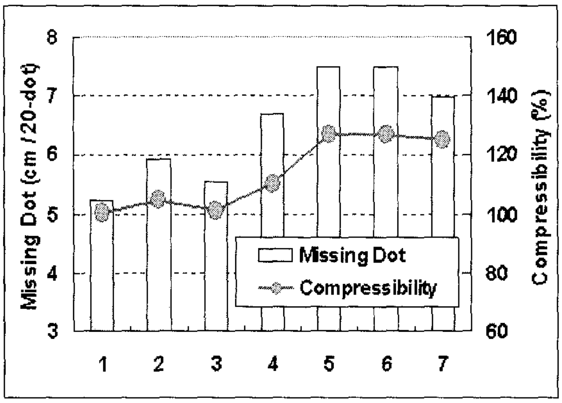

Fig. 4 Missing dot and compressibility

3. 5 Ink gloss and SNAP of coated board

Both ink gloss and SNAP of coated board was improved with increasing talc addition. This is also due to the shape of talc, forming bottle neck pore structure and hence prohibiting the penetration of ink. The reason for the improved SNAP was because the increment in ink gloss was higher than the loss in paper gloss.

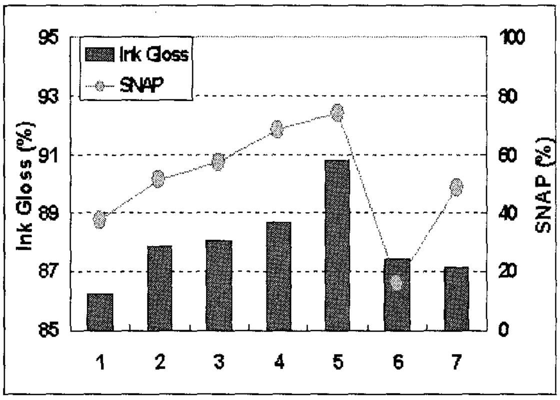

Fig.5 Paper gloss and SNAP

IV. Conclusions

1. Water retention was increased with increasing the talc content while viscosity was reduced.

2. Roughness was slightly decreased and paper gloss was significantly reduced with increasing talc addition.

3. Porosity of coated board was slightly increased with increasing the talc content.

4. Missing dot and compressibility of coated board was increased with increasing the talc content.

5. Both ink gloss and SNAP of coated board were increased with increasing the talc content.

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