The Korean trend and Case Study for High Solids Coating regarding Coated Board(CDB) & Art Board

David Park
South Korea

1. The concept of high solids coating

- ☞ When solid contents is 68~69.5% at Mixer(Blending tank)
- ☞ World best : 70% at Mixer
- ☞ World best at returning tray : (Solids at Mixer + 1.5~2%) in using slurry type GCC 95,and (Solids at Mixer +2.0~2.5%) in using slurry type GCC 60.
- ☞ Korean CDB's case : 66~70% at Mixer
- ☞ Korean Art Paper's case : 68~72% at Mixer

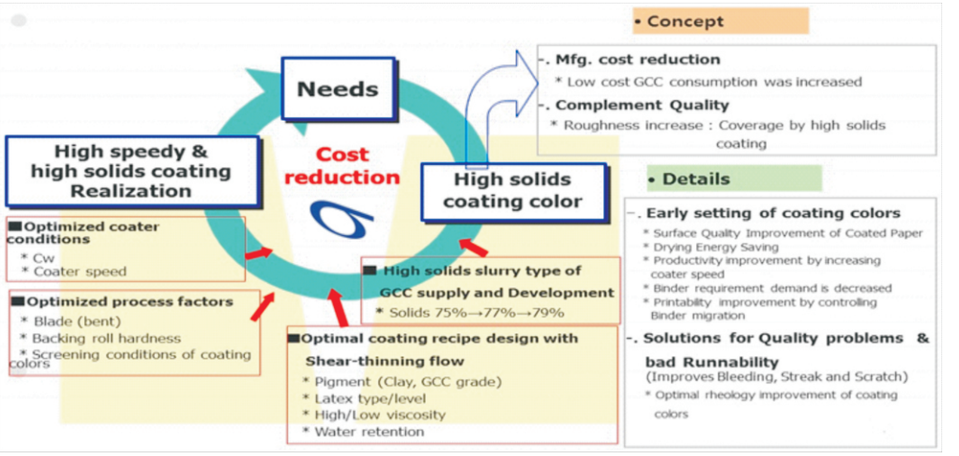
2. Needs of high solids coating

- ☞ Productivity Improvement by high speedy coater
- ☞ Manufacturing cost reduction of coated board
- ☞ Quality Improvement & Runability Improvement

3. Advantages and Drawbacks of high solids coating

- ☞ Advantage
  - Better hold-out→ optical characteristics
  - Reduced binder demand
  - Significant savings in drying energy
  - ▸ cost savings

Drying energy : +2% on coating color solids is estimated at Min. 5 USD / T of coating color_ saved on drying costs



- Higher water retention / Less additives
- Better smoothness & gloss
- Lower level of biocide required

▸ higher solids and less starch can reduce the need for biocides

- Dusting Problems like Hickey,Whitening in printing was improved due to using 100% slurry type of Calcium Carbonate
- Show through was improved due to Ink set-off improvement under 100% slurry type of Calcium Carbonate

☞Potential drawbacks

- Excessive blade load (blade wear)
- Rheology limitation (scratches, bleeding,etc.)

4. Process Factors to have an influence on high solidscoating

Base paper

-. Porosity
-. Roughness
-. Basis weight

Coating color

-. Pigments (fineness, Particle size distribution, shape, density)
-. Latex type / level
-. Low and high shear viscosity
-. Temperature
-. Synthetic thickener type / level
-. Water soluble polymers (CMC, starch)
-. Water retention capability

Blade geometry / coater type

-. Bent blade is better for high solids
-. Blade thickness (0.457mm and 0.508mm)
-. Hardness of backing roll is related to SB-Latex

Coater conditions

-. Coat weight
-. Speed
-. On/off-line

5. Problems & Solutions according to applyinghigh solids coating colors

■ * **Problems in free of Clay**

1) Poor Smoothness2) Gloss will be dropped(Opacity will be dropped)

■***Solutions**

1. Poor Smoothness at high GCC→ Immobilization points speed up by high solids coating colors → Smoothness & Gloss will be improved→Prevent Binder Migration →Bulky Coated Layer→Print Mottle Improvement

■* **Problems**(High shear viscosity increase)

1) Bad coating runability2) Water retention dropped3) Bleeding 4) Streak 5) Scratch

■***Solutions**

1. Replaces Synthetic thickener by Rheology modifier

※ Shear-thickening flow → Improvement by Shear-thinning flow behavior (Specialty Co-binder is better for increasing elastics of coating color)

(It is difficult to control elastics of coating color by adjusting Tg value)

※ Rheology, Water retention and Runnability improvement by uniform moisture contents and uniform particle distribution in the coating colors

2. Clay with small CD: MD ratio and wide particle size distribution is better for high shear rheology charateristics if little amounts of Clay is used

※ It improves bleeding & lubricant effect between GCC and this Clay because GCC size is bigger than Clay.

3. SB-Latex selection of small particle size

※ Rheology improvement by large ball bearing effect(Incase of too small,Mottle can be generated)

4. Additives demand will be decrease (OBA, Biocide)

6. Korean trend for Solids in 2016 against 2005-Coated Duplex Board-

Item	A	B	C
Grammage (GSM)	210~400	210~400	210~400
Color solid contents (%)/2005	Precoat : 40% and 65% Topcoat : 60%	Precoat : 60% Topcoat : 60%	Precoat : 65% Topcoat: 60%
Color solid contents (%)/2016	Blank data will be provided in presentation only		
Type of coating	Double	Double	Double
Annual production(MT)	Blank data will be provided in presentation only		

7. Korean trend for Pigment & Binder ratio in 2001 -Coated Duplex Board-

Item	A	B	C
CLAY No.1(PPH)	20~40	40	40
GCC 90(PPH)/Slurry type	60~80	60	60
CLAY No.2(PPH)	20	30	30
GCC 60(PPH)/Slurry type	80	70	70
Topcoat Binder(PPH)	12~13.5	13~14	13~14
Precoat Binder(PPH)	13	14	14

8. Korean trend for Pigment & Binder ratio in 2016 -Coated Duplex Board-

Item	A	B	C
CLAY No.1(PPH)	0	0	0
GCC 95(PPH)/Slurry type	Blank data will be provided in presentation only		
CLAY No.2(PPH)	0	0	0
GCC 60(PPH)/Slurry type	100	100	100
Topcoat Binder(PPH)	Blank data will be provided in presentation only		
Precoat Binder(PPH)	Blank data will be provided in presentation only		

9. Annual Cost Reduction for Pigment & Binder in 2016against 2001 -Coated Duplex Board-

Item	A	B	C
CLAY No.1-GCC 90	253,844USD	84,592USD	225,626USD
On the basis of	Cw : 28gsm(28/0.9=31.1/300=10.37%),Precoat : Topcoat =60% :40% Clay No. 1 : 220USD/MT,GCC 95 : 186USD/MT,SB-Latex : 800USD/MT A : 600,000MT X 10.37%=62,220MT B : 150,000MT X 10.37%=15,555MT C : 400.000MT X 10.37%= 41.480MT		
Binder Reduction	(26-19.5)PPH=6.5PPH 3,235,200USD	(28-20.5)=7.5PPH 923,800USD	(28-19.5)PPH =8.5PPH 2,820,000USD
On the basis of	62,220MT*0.065=4,044 MT*800 USD=3,235,200USD	15,555MT*0.075=1,166M T*800USD=923,800USD	41,480MT*0.085= 3,525MT*800USD= 2,820,000USD
Others	1. Clay No. 2 cost reduction is excluded 2. Additives cost reduction is excluded 3. Energy cost reduction is excluded		

10. Case Study : Comparison between slurry type of GCC 95 and Powder type of GCC 90 -Coated Duplex Board

Item	Unit	Topcoat only	
		Clay No. 1 50% + Powder type of GCC 90 50%	Clay No. 1 50% + Slurry type of GCC 95 50%
Other conditions		Same	
Solid contents at Mixer	%	65	66
Smoothness	PPS/Micron	1.29	1.30
Gloss	75°	45	49
Mottling			+ Side
Coverage			Improved

11. Korean coating recipe and others in 2016 – Coated Duplex Board-*Blank data will be provided inpresentation only*

Items	A		B		C	
	Precoat	Top coat	Precoat	Top coat	Precoat	Top coat
#1 Clay						
GCC 95						
GCC 60						
S/B latex						
Cw Improver						
Insolublizer						
lubricant						
Specialty Cobinder						
Special Rheology Modifier						
Solids(%) at Mixer						
Viscosity(LVT SP.NO.3 rpm 60)						
Type	Rod Bar	Tungsten Blade	Rod Bar	Tungsten Blade	Rod Bar	Tungsten Blade
PH						
Solids(%) at Returning						
CW(gsm)						
250 GSM T/Layer Furnish	HWS,WL,SOP,BKP and PMC		WL ,SOP and BKP		WL,SOP,BKP and PMC	
UT/Layer Furnish	ONP		ONP		ONP	
CW(gsm)						
350 GSM T/Layer Furnish	HWS,WL,SOP, and PMC		WL and SOP		HWS,WL,SOP, and PMC	
UT/Layer Furnish	OCC		ONP		ONP	

12. Effect according to applying high solids coating colors-South Korean Case Study (1) at Art Paper in 2010-

1) Increased low cost GCC consumption against Clay and Additives consumption decreased
(Brightness, Gloss, Roughness and Printability was nearly same to before and after)

Item	Low solids color	High solid color	Reduction Effect	Approx. 4,822,000,000KW/Y (Based on Single Art paper 210,000mt/y)
Color Solids	65~66%	70%		
Clay	40	20	50%	
Binder level	13	11	15%	◦ Clay is higher than GCC in Binder consumption
OBA	1.5	1.0	33%	◦ OBA decrease by using GCC with brightness against Clay

13. Effect according to applying high solids coating colors -South Korean Case Study (2) at Art Paper in 2010-

2) Drying Energy Reduction
Energy reduction because moisture contents included in GCC coating colors is lower than Clay lower

Item		Low solids color (Mean value of the 5 Nos.)	High solids color (Mean value of the 5 Nos.)	Reduction Effect	Approx. 575,000,000/Y (Based on Single Art paper 210,000mt/y)
Drying Energy (Air Chamber) (℃)	#1	146℃	134℃	Approx. 10℃	
	#2	134℃	122℃		
Conditions	1. 5 hot air chamber on coating head #1 & #2 2. BP MO (3.5%) , Coated Paper MO of 5.5% 3. Same speed (550 m/min) – IHI(Japan) maintained 4. BP(200g/m2), CP(250 g/m2)- Cw 50g/m2 two-sided 5. Coating color solids : Low solids color(68%), High solids color(71%) ■Effect calculation = 5Euro/Coating color Ton = 5*1,660*(210,000*0.33) = 575,190,000KW/Y				

14. Effect according to applying high solids coating colors -South Korean Case Study (3) at Art Paper in 2010-

3)Productivity Improvement by Speed UP
Speed up by quick drying is possible because moisture contents amounts included in coating colors

Item	Low solids color	High solids color	Improvement Effect	254,100 MT/Y (+44,100MT/Y) (Based on Single Art paper 210,000mt/y)
Coater Speed (m/min)	700	850	21%	Speed up = + 150 m/min
Conditions	1. Coater maker : Voith Sulzer (Germany) 2. 5 hot air chamber on coating head #1 & #2 2. BP MO (3.5%) , Coated Paper MO of 5.5% 3. Drying temperature was same 4. BP(67g/m2), CP(100 g/m2)- Cw 33g/m2 two-sided 5. Coating color solids : Low solids color(68%), High solids color(71%) ■Effect calculation = 5Euro/Coating color Ton = 5*1,660*(210,000*0.33) = 575,190,000KW/Y ■ Effect Calculation = 210,000 + (210,000*0.21) = 254,100 MT/ Approx. 8,300KW/MT reduced			

15. Production Capacity & Speed in 2010 (2016) atSouth Korean manufacturers – Art Paper-

Item	H		S		M	HK	
	PM 1	PM 2	Unit 1	Unit 2		PM 1	PM2
Design Speed	These data will be provided in presentation						
Operating Speed(2016)							
Grammage (GSM)	70~100(L)	-	70~150(M)	180~250(H)	70~100(L)	70~100(L)	180~250(H)
Color solids(2016)	69(72)	-	69(70)	71	68	69(71)	69(71)
Type of coating	Double	Double	Double	Single	Double	Double	Double
Annual production(MT)	These data will be provided in presentation						

16. Suggestion

- ☞ Recommend to increase solid contents of coating color at Mixer step by step (+ 1~2%)
- ☞ Optimal specialty water retention agent and specialty Rheology modifier shall be applied and selected, otherwise Quality problem can be generated.
- ☞ Optimal Binder conditions shall be considered at high solids and 100% CacO3 rich structure.
- ☞ Recommend to use simple additives(Less consumption)
- ☞ Instruction from professional expert with actual experiences will be required for responding & solving lots of Quality problems showing in the process of Solid-up