

Studies on the blister pack

Blister pack 특성에 관한 연구

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LG화학



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Effect of Binder on Blister Pack

July 1st, 2004

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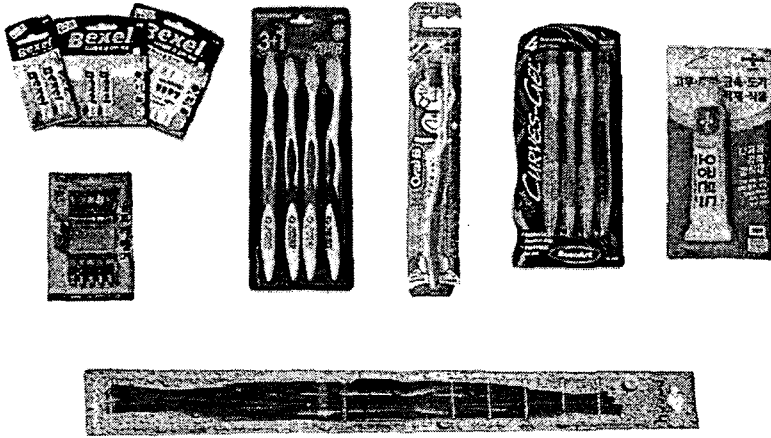
Performance Polymers R&D / Tech Center

Introduction



Typical Examples

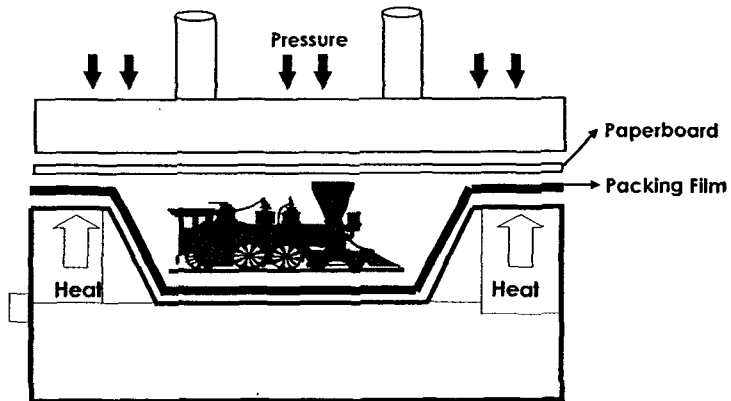
Introduction



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Heat Welding

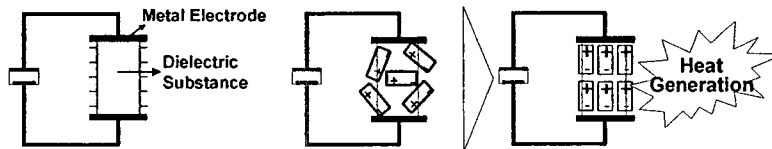
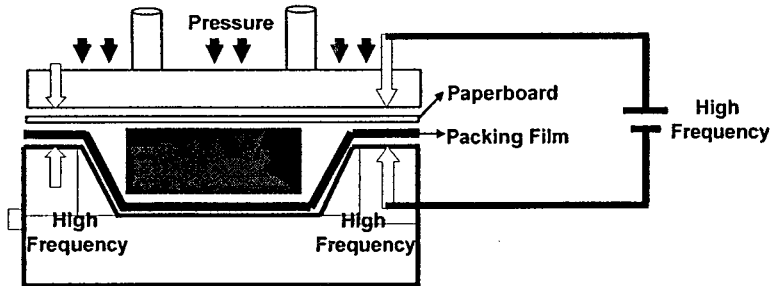
Introduction



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High Frequency Welding

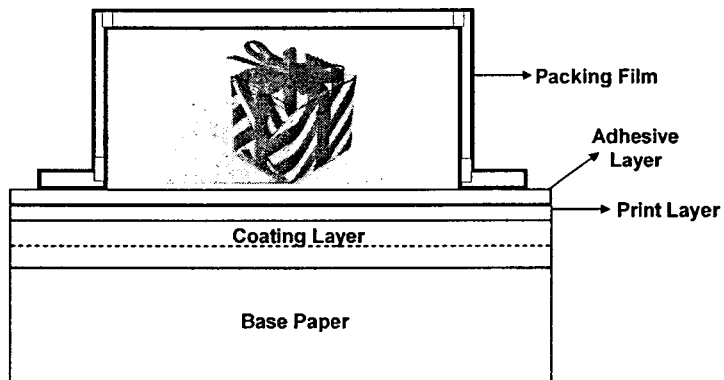
Introduction



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Structure of Blister Pack

Introduction

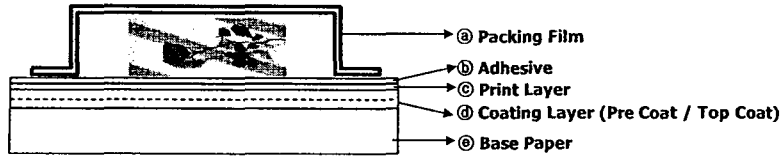


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Trouble of the Blister Packing

Introduction

Some cases of trouble of blister packing



㉑* : Point between ㉑ and ㉒
 ㉒* : Point between ㉒ and ㉓

㉓* : Point between ㉓ and ㉔
 ㉔* : Point between ㉔ and ㉕

	Position of Failure	Failure mode	Performance
Case I	㉑*	Adhesive Failure b/w ㉑ and ㉒	Very Unsatisfactory
Case II	㉒*	Adhesive Failure b/w ㉒ and ㉓	Very Unsatisfactory
Case III	㉓*	Adhesive Failure b/w ㉓ and ㉔	Very Unsatisfactory
Case IV	㉔	Cohesive Failure in Pre or Top Coat	Unsatisfactory
Case V	㉔*	Adhesive Failure b/w ㉔ and ㉕	Unsatisfactory
Case VI	㉕	Cohesive Failure in Base Paper	Unsatisfactory

Salfactory
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Trouble of the Blister Packing

Introduction

Factors Affecting the Performance of Blister Pack

- Plastic Film and Welding Machine
 - ✓ Film Material : PVC, PE, PS, PET, PP etc.
 - ✓ Properties of Film : Heat Transfer Coefficient, Friction Coefficient etc.
 - ✓ Sealing Area and Dimensions of Film
 - ✓ Welding Conditions : Temperature, Pressure, Current...
- Adhesive
 - ✓ Types and Composition of Resin, Plasticizer, Solvent, Tackifier, etc.
- Printing Ink
 - ✓ Ink Type
 - ✓ Polarity of Ink
 - ✓ Penetration Depth of Ink into the Coat Layer

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Typical Composition of Adhesive for Blister Pack

Component	Composition (wt %)	Typical Example
Resin	30.0	PVC Copolymer (Polyvinyl Chloride)
Plasticizer	5.0 ~ 10.0	DOP (Dioctyl Phthalate)
Solvent	60.0 ~ 65.0	Toluene



Effective factors of blister packing trouble

➤ **Coating Color**

- ✓ Types of Pigment : Organic and Inorganic, CaCO₃, Clay etc.
- ✓ Characteristics of Binder
- ✓ Binder Level
- ✓ Distribution of Binder along the Coat Layer (Binder Migration)
- ✓ Types of Thickener and Thickener Level
- ✓ Additives : Water Resistance Agent, lubricant, Defoamer etc.

- ✓ Color Formulation : Concentration, Pigments Ratio etc.
- ✓ Water Retention of Coating Color
- ✓ Coating Weight
- ✓ High Shear Viscosity of Coating Color



Effective factors of blister packing trouble**> Paper**

- ✓ Roughness & Smoothness
- ✓ Weight : Base Paper, Coating
- ✓ Moisture Contents
- ✓ Porosity
- ✓ Formation of Base Paper
- ✓ Surface Strength of Coating Paper
- ✓ Drying Condition
- ✓ Calendering Condition
- ✓ Picking Strength : Under and Top Coating Layer
- ✓ Adhesion Strength between Base Paper Piles

**◆ Mechanical Interlocking**

- ✓ Macroscopic Scale
- ✓ Pores and Projections

◆ Chemical Bonding

- ✓ Primary Bond
- ✓ Secondary Bond

◆ Electrostatic Attraction

- ✓ Interaction between charges created on both sides of the contact area
- ✓ Electric Double Layer

◆ Interdiffusion

- ✓ Molecular Level

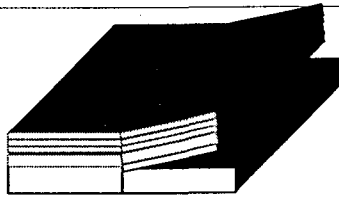
◆ Adsorption

- ✓ Thermodynamic

General Considerations

Introduction

Plastic Film
Adhesive
Print Layer
Pre and Top Coat
Base Paper



Satisfaction Criteria for the Good Blister Pack
- Failure inside the base paper

Assumption

- ◆ Strong adhesion between plastic film and adhesive
- ◆ Strong adhesion between coating layer and base paper
- ◆ Interaction of adhesive with print and coat layer
 - major factor for the performance of blister pack
 - ✓ Mechanical Interlocking
 - ✓ Electrostatic Interaction
- ◆ Binders can control the coating structure.

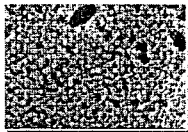


Approach 1 – High Tg Latex

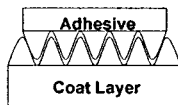
Introduction

High Tg latex endows open pores to the coating structure. These pores help adhesive penetrating into the coat layer, and improve the adhesion.

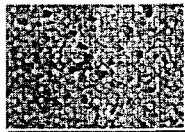
<High Tg Latex>



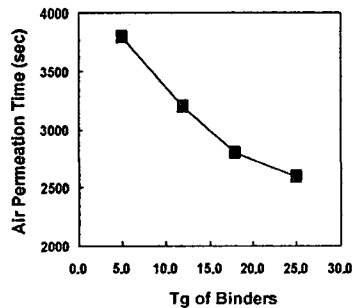
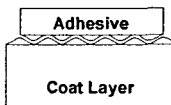
- Porous Structure
- Mechanical Interlock



<Low Tg Latex>



- Less Porous
- Surface Adhesion

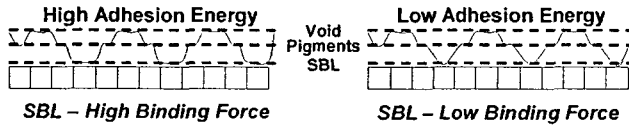
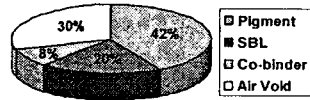


Approach 2 – SBL of High Binding Force *Introduction*

Electrostatic interaction and interdiffusion endow much stronger adhesion energy than other mechanism. So the interaction between adhesive and SBL is very important.

Materials	Parts (weight)	Parts (volume)
Pigments	100	49
SB Latex	12	17
Co-binder	3	4
Air Void	-	30

Surface Occupation



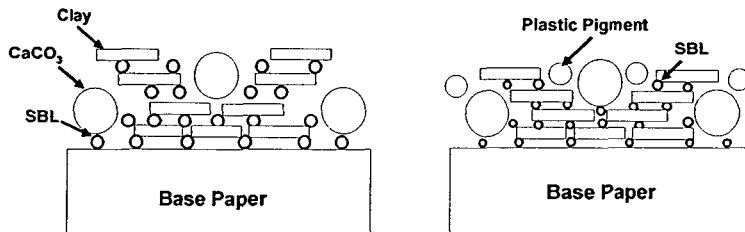
Approach 3 – Plastic Pigment *Introduction*

$$\left(\text{Good Adhesion} \right) = \left(\text{Mechanical Interlocking} \right) + \left(\text{Electrostatic Interaction} \right) + \left(\text{Inter-diffusion} \right)$$

High Tg Latex
SBL of High Binding Force

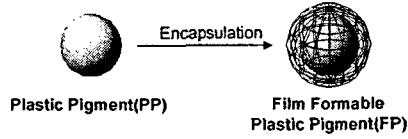
◆ Candidate – Plastic Pigment

- ✓ Advantage - It may increase the porosity and interaction with adhesive.
- ✓ Disadvantage - It may deteriorate the pick strength of the coating layer.



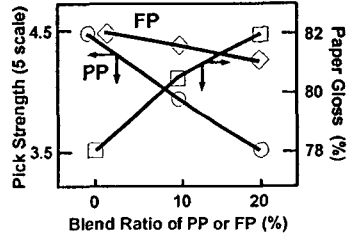
Approach 3' – Film Formable Plastic Pigment

- ◆ Encapsulation of PP with thin layer which has film forming capability.
 - ✓ It produces a porous structure while maintaining the pick strength.



Materials	Parts (weight)	Parts (volume)	Surface Occupation
Pigments	90	40	34
FP *	10	13	15
SB Latex	10.5	13	16
Co-binder	3	4	7
Air Void	-	30	28

* FP : Film Formable Plastic Pigment



Experiments



Experiments Design

Experiments

Latex comparison test – Coating color formulation

➤ Pre coating color

Base color	TSC ? =	65%
Ingredient	Grade	Net
Clay	#2	20.00
	FMT-65	80.00
CaCO ₃	Protein	2.80
	Aron T-40	0.10
SB Latex		13.00
NaOH		0.00
Insolubiliser		0.00
Lubricant		0.00
F/WM		62.41
Sub Total		178.31

➤ Top coating color

Base color	TSC ? =	64%	64%
Ingredient	Grade	Net	Net
Clay	#1	30.00	20.00
	FMT-90	70.00	70.00
CaCO ₃	CMC	3.00	3.00
	Aron T-40	0.30	0.30
SB Latex		13.00	10.50
230FP		-	10.00
NaOH		0.10	0.10
Insolubiliser		0.80	0.80
Lubricant		0.95	0.95
F/WM		66.46	65.05
Sub Total		184.61	180.70



Experiments Design

Experiments

Latex comparison test – Latex

No.	Latex	Tg	Parts		Coating Type
			Pre	Top	
1	LX 5	5 °C	13.0	13.0	Bar Coating / MLC(Blade)
2	LX 12	12 °C	13.0	13.0	Bar Coating / MLC (Blade)
3	Lx 18	18 °C	13.0	13.0	Bar Coating / MLC (Blade)
4	Lx 25	25 °C	13.0	13.0	Bar Coating / MLC (Blade)
5	LX 5 / FP	-	13.0 / 0	10.5 / 10.0	Bar Coating / MLC (Blade)
6	LX 18 / FP	-	13.0 / 0	10.5 / 10.0	Bar Coating / MLC (Blade)

➤ MLC (Malyo Laboratory Coater)

- ✓ Blade type coater, Speed : 100 m/sec,
- ✓ Drying Cond'n : IR 30%, 130°C, 4sec
- ✓ Calendering : 80°C, 500kPa



Experiments Method

Experiments

Blister packing test

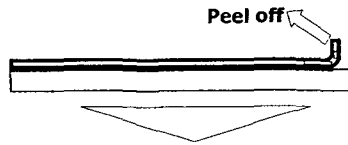
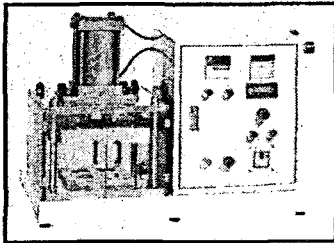
1. Coating

- Bar and MLC coating

2. Printing & Adhesive coating

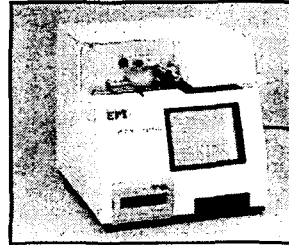
- RI Tester

3. Blister pack Tester



4. Peel tester

-It measures the force required to peel off the film from paper.



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Results I

Latex Comparison Test

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Coating Color Properties

Results I

> Top coating color Properties

No.	Latex	Solids	pH	Viscosity		Water Retention (g/m ²)
				Low Shear (cps)	High Shear (E4*dyne/ cm)	
1	LX 5	64.0 %	9.26	2360	23.8	146.9
2	LX 12	64.0 %	9.38	2280	22.7	158.3
3	Lx 18	64.0 %	9.33	2200	22.2	167.3
4	Lx 25	64.0 %	9.25	2010	21.7	169.8
5	LX 5 / FP	64.0 %	9.20	2980	23.4	132.3
6	LX 18 / FP	64.0 %	9.16	2810	21.7	147.3



Paper & Printing Properties

Results I

- Bar Coating
- Calendering Condition : 80°C, 500 kPa (Low Pressure)

No.	Latex	Paper Properties					Printing Properties			
		Coated Weight (g/m ²)	Gloss		PPS (μm)	Permeability (sec)	Dry Pick		Wet Pick	Ink set-off
			Sheet (%)	Print (%)			IGT	RI		
1	LX 5	27.0	50.7	80.2	2.59	1835	249	4.3	4.2	4.0
2	LX 12	27.0	57.9	79.7	2.38	1711	202	4.0	4.1	4.2
3	Lx 18	27.0	62.2	78.7	2.33	1519	175	3.8	3.8	4.4
4	Lx 25	27.0	64.7	76.7	2.24	1508	164	3.6	3.5	4.5
5	LX 5 / FP	27.0	58.0	78.3	2.57	1837	252	4.4	4.2	4.0
6	LX 18 / FP	27.0	67.6	72.5	2.61	1345	209	4.2	4.0	4.2



Paper & Printing Properties

Results I

- Bar Coating
- Calendering Condition : 80°C, 5500 kPa (High Pressure)

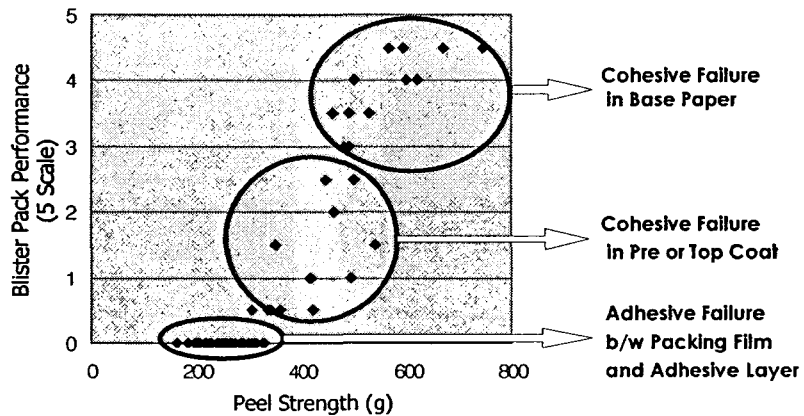
No.	Latex	Paper Properties					Printing Properties			
		Coated Weight (g/m ²)	Gloss		PPS (μm)	Permeability (sec)	Dry Pick		Wet Pick	Ink set-off
			Sheet (%)	Print (%)			IGT	RI		
1	LX 5	27.0	63.9	84.7	1.67	2218	328	4.1	4.2	3.8
2	LX 12	27.0	69.5	79.3	1.63	1930	289	3.9	4.0	4.0
3	Lx 18	27.0	75.1	74.5	1.63	1868	254	3.6	3.9	4.2
4	Lx 25	27.0	77.0	73.1	1.58	1716	237	3.4	3.8	4.2
5	LX 5 / FP	27.0	72.1	84.9	1.65	2141	341	4.4	4.4	3.8
6	LX 18 / FP	27.0	80.1	76.4	1.64	1722	279	4.0	4.2	4.0



Blister Packing Test

Results I

Peel Test – Blister Pack Relation

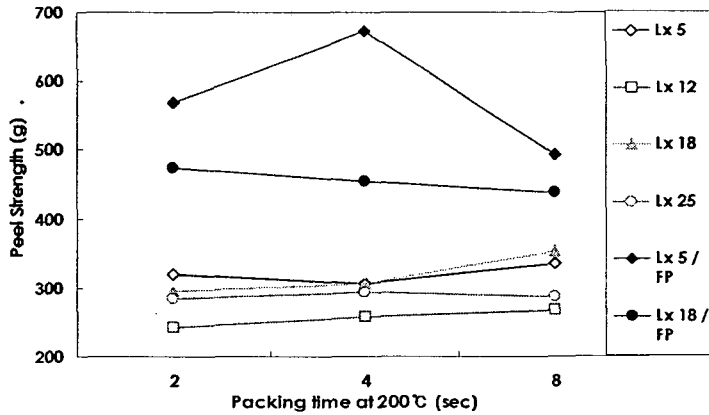


Blister Packing Test

Results I

Peel Test Results – Comparison according to latex

- MLC Coating / Drying Cond'n : IR 30%, 130°C, 4sec / Calendering : 80°C, 500kPa
- Packing condition : Packing time 2, 4 and 8 second at 200°C

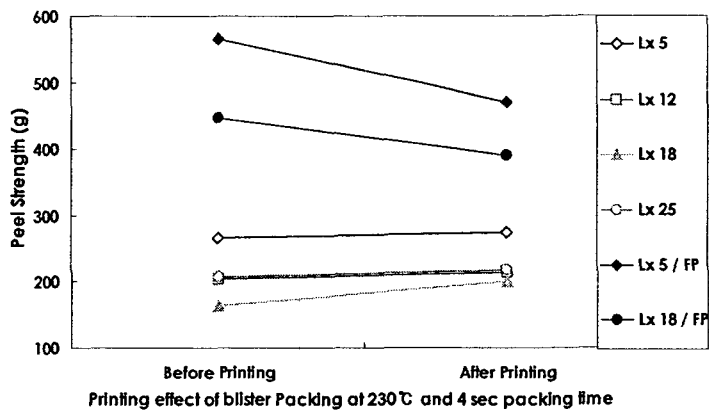


Blister Packing Test

Results I

Peel Test Results – Effect comparison of printing

- Bar Coating / Drying Cond'n : 105°C, 30sec / Calendering : 80°C, 500kPa
- Packing condition : Packing time 4 second at 230°C

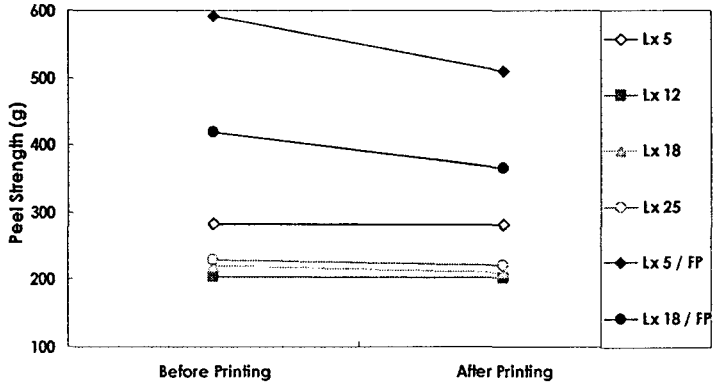


Blister Packing Test

Results I

Peel Test Results – Effect comparison of printing

- Bar Coating / Drying Cond'n : 105°C, 30sec / Calendering : 80°C, 500kPa
- Packing condition : Packing time 8 second at 230°C



Printing effect of blister Packing at 230°C and 8 sec packing time

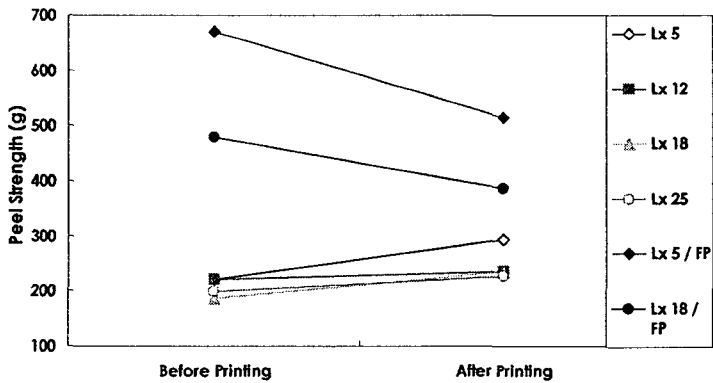


Blister Packing Test

Results I

Peel Test Results – Effect comparison of printing

- Bar Coating / Drying Cond'n : 105°C, 30sec / Calendering : 80°C, 550kPa
- Packing condition : Packing time 4 second at 230°C



Printing effect of blister Packing at 230°C and 4 sec packing time

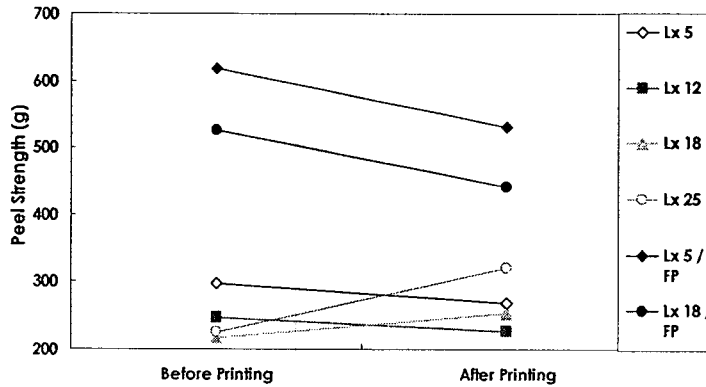


Blister Packing Test

Results I

Peel Test Results – Effect comparison of printing

- Bar Coating / Drying Cond'n : 105°C, 30sec / Calendering : 80°C, 5500kPa
- Packing condition : Packing time 8 second at 230°C



Printing effect of blister Packing at 230°C and 8 sec packing time



Results II

Paper Comparison Test



Paper & Printing Properties

Results II

Ivory Paperboard Samples

- The comparison of Ivory paperboard on the market (Korea, China)

N o.	Sample	Paper Properties						Printing Properties			
		Weigh t (g/m ²)	Bulky Densit y (g/cm ³)	Gloss		PPS (μ m)	Perme ability (sec)	Dry Pick		Wet Pick	Ink set- off
				Shee t (%)	Print (%)			IGT	RI		
1	Sample A 250GSM	252.4	0.091	55.7	85.3	1.95	3351	274.9	4.3	3.5	3.8
2	Sample B 260GSM	274.3	0.088	67.6	85.2	1.69	1761	176.5	4.0	3.8	4.2
3	Sample C 260GSM	267.0	0.085	63.4	84.0	1.95	2541	123.7	3.8	4.2	4.0

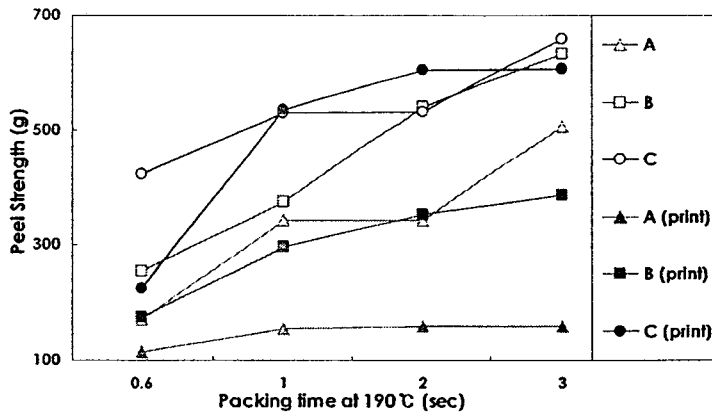


Blister Packing Test

Results II

Peel Test Results – Effect of printing and packing time

- Packing condition : Packing time 0.6, 1.0, 2.0 and 3.0 sec at 190°C



Paper & Printing Properties

Results II

Royal-ivory Paperboard Samples

- The comparison of Royal-ivory paperboard on the market (Korea, China)

N o.	Sample	Paper Properties						Printing Properties			
		Weigh t (g/m ²)	Bulky Densit y (g/cm ³)	Gloss		PPS (μm)	Perme ability (sec)	Dry Pick		Wet Pic k	Ink set- off
				Shee t (%)	Print (%)			IGT	RI		
1	Sample D 350GSM	346.8	0.073	54.7	88.5	1.65	2817	221.6	4.3	3.8	4.0
2	Sample E 350GSM	364.6	0.083	51.9	83.7	1.90	2145	95.7	3.9	4.2	3.9
3	Sample F 350GSM	353.0	0.080	64.1	80.3	1.47	2205	166.8	4.0	4.0	4.3

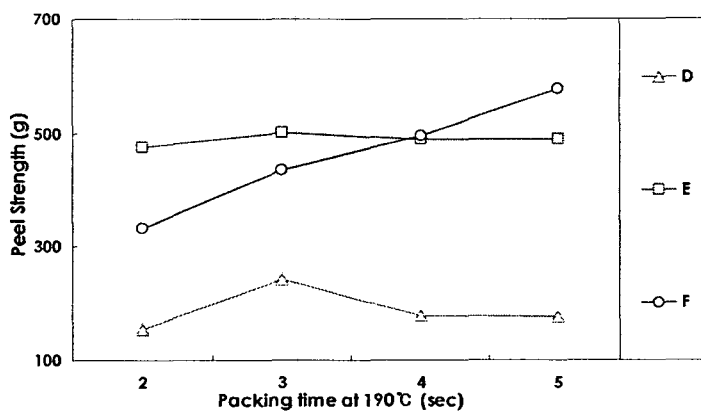


Blister Packing Test

Results II

Peel Test Results – Effect of printing and packing time

- Packing condition : Packing time 2, 3, 4 and 5 sec at 190°C



- Thank you !! -

