

# SK Chemicals - SKYBON



# Green Chemical Biz Coating & Adhesive Group

**SKY**BON

Saturated Co-polyester for C.A.S.E

## ✓ Line up

### ES Solvent-borne

- Amorphous polymer
- Solvent soluble



- PCM<sup>(1)</sup> for appliances
- Can coating & Ink
- Industrial adhesives

### EW Water-borne

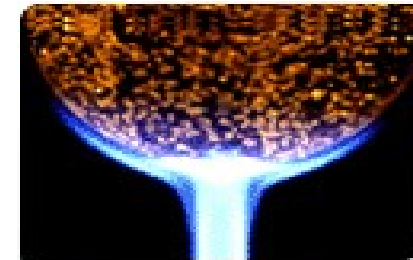
- Readily dispersible in water



- Sizing agent for textiles
- Adhesive, Binder

### EH Hot melt

- Crystalline polymer



- Can seam sealing
- Label and spangle
- Automotive filter

## ✓ New line up

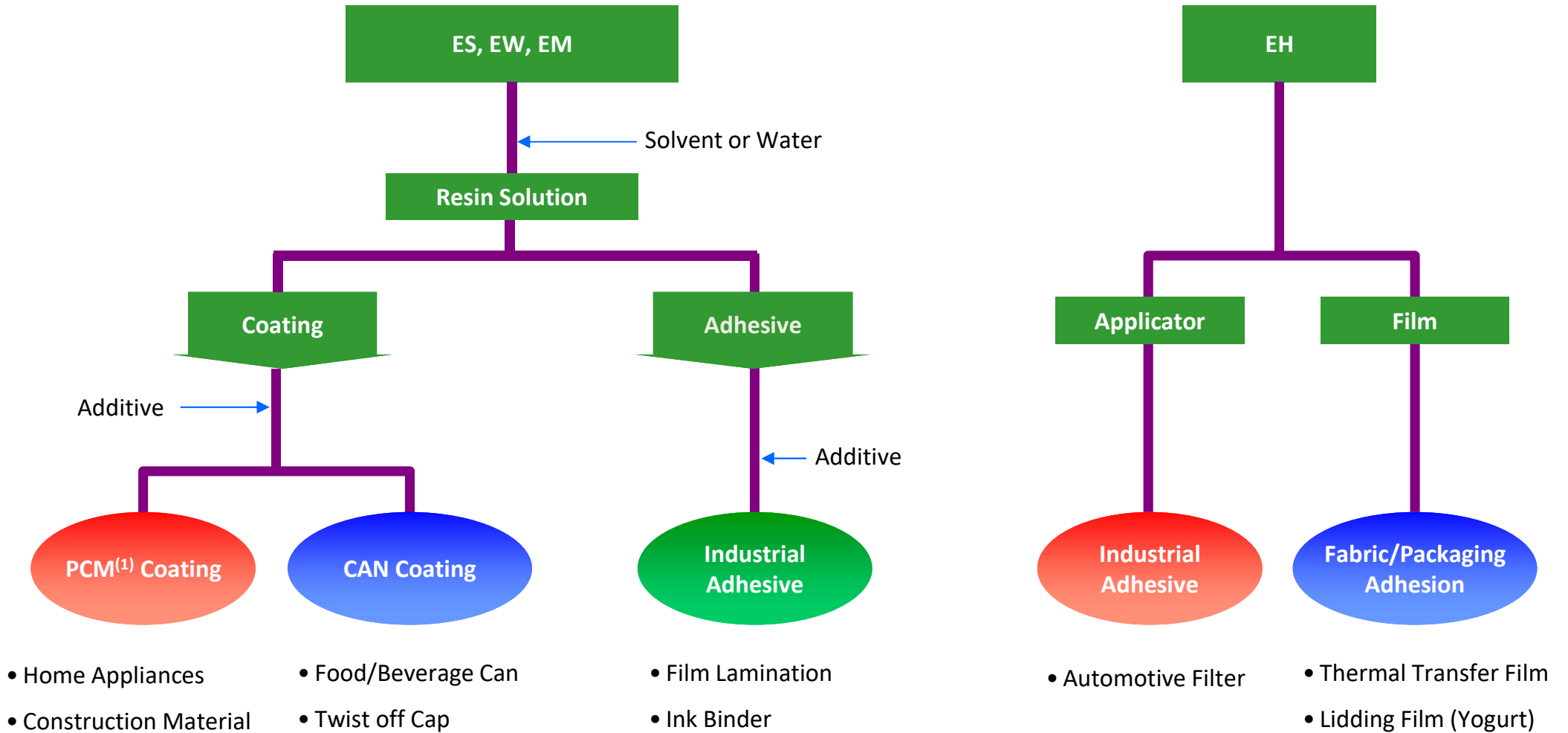
### HiPES

- Solvent-borne
- Heat resistance

### EM

- Emulsion polyester

(1) Pre-Coated Metal(Coil coating)



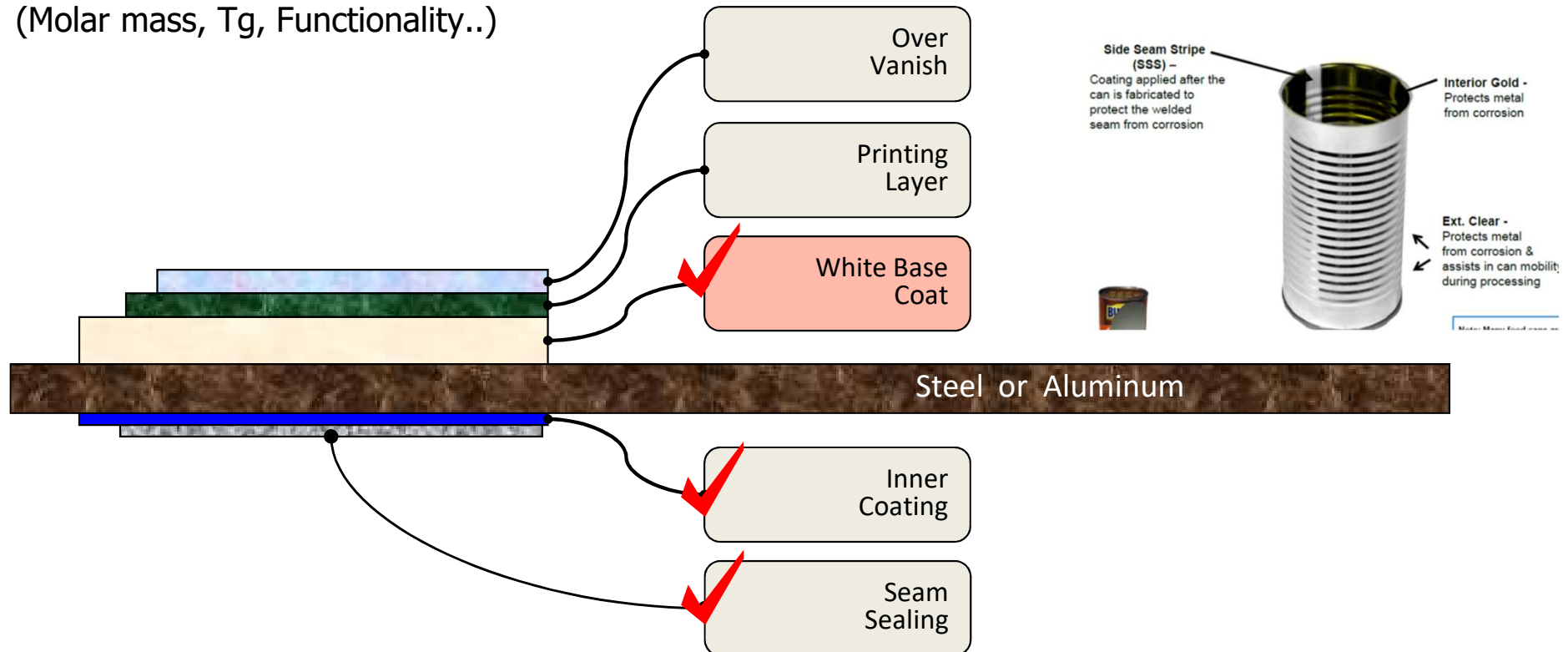
(1) Pre Coated Metal

# Main Application – Can Coating

## ✓ Key Benefit of SKYBON

- BPA free
- Excellent flexibility
- Outstanding adhesion to metal surface
- Wide range of properties

(Molar mass, Tg, Functionality..)



# Main Application – Can Coating



Grade	Type	IV <sup>(1)</sup> (dl/g)	Mn <sup>(2)</sup>	Tg (°C)	OHV (mgKOH/g)	AV (mgKOH/g)	Features
ES 120	L	0.59	28,000	70	2~6	< 3	Good Sterilization, Flexibility
ES 350	L	0.77	32,000	15	1~5	< 3	Excellent flexibility
ES 420	L	0.50	16,000	47	4~8	< 3	Sterilization-flexibility balance
ES 460M	B	0.47	7,000	37	5~9	3 ~ 7	Phenol curing response Low Tg & good adhesion
<b>ES 660</b>	<b>L</b>	<b>0.46</b>	<b>18,000</b>	<b>71</b>	<b>5~11</b>	<b>&lt; 3</b>	<b>High Tg Excellent sterilization resistance</b>
ES 670	L	0.74	30,000	45	1~5	< 3	Sterilization-flexibility balance
ES 680	B	0.58	20,000	57	3~8	2~6	Phenol curing response Sterilization-flexibility balance Excellent adhesion
<b>ES 770</b>	<b>B</b>	<b>0.48</b>	<b>16,000</b>	<b>68</b>	<b>6~10</b>	<b>&lt; 3</b>	<b>Excellent sterilization resistance</b>

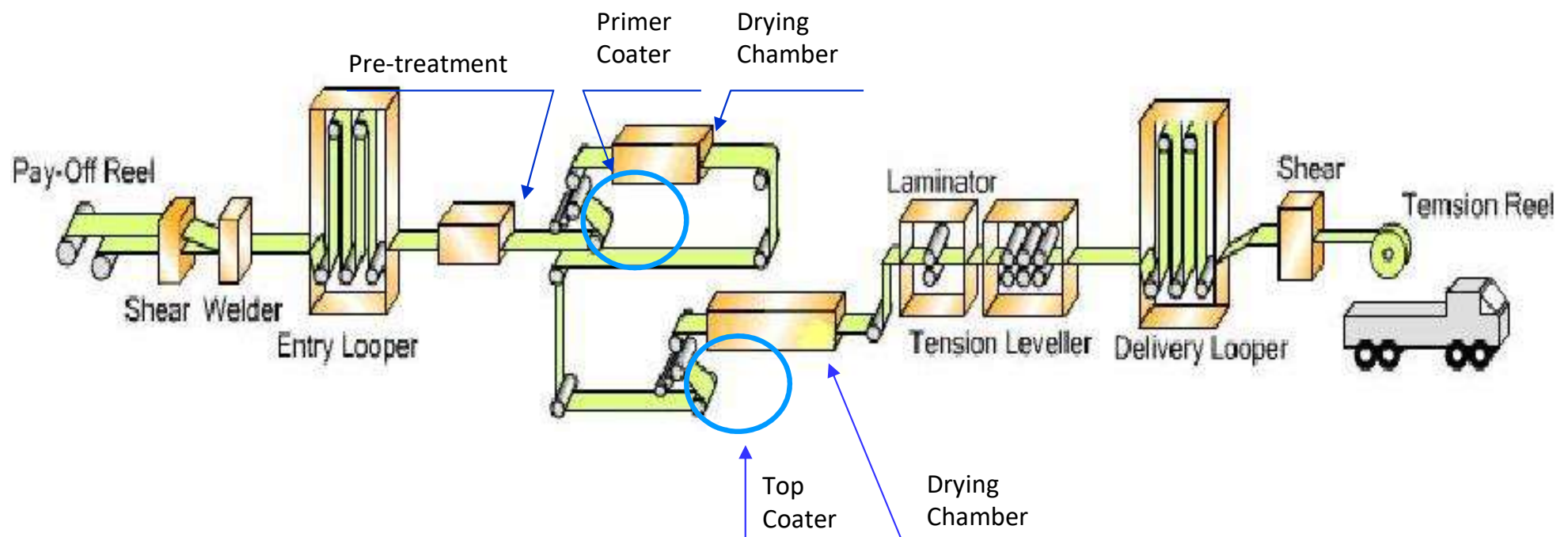
(1) o-chlorophenol @ 35°C

(2) GPC data tested with THF, Relative Standard Deviation ± 10%

# Main Application – Coil coating

## ✓ Key Benefit of SKYBON

- High molecular weight polymer endows tough and very flexible properties
- Outstanding chemical resistance
- Excellent adhesion to metal as a primer
- Heat resistance
- High gloss as a top coating





# Main Application – Coil coating



# Coil Coating Grades



Grade	IV <sup>(1)</sup> (dl/g)	Mn <sup>(2)</sup> (g/mol)	Tg (°C)	SP (°C)	OHV (KOH mg/g)	AV (KOH mg/g)	Structure <sup>(3)</sup>	Shape	Remark
ES 110	0.53	18,000	65	135	2 - 6	<3	L	Pellet	Ink Binder Top, Primer
ES 215	0.85	35,000	-11	100	2 - 6	<3	L	Sheet	Primer
ES 360	0.72	28,000	17	110	1 - 5	<3	L	Sheet	Primer
ES 420	0.50	16,000	47	130	4 - 8	<3	L	Pellet	Top Primer
ES 450	0.50	18,000	50	130	4 - 8	<3	L	Pellet	Top Primer
ES 500	0.70	26,000	10	90	2 - 6	<3	L	Sheet	Primer
ES 510	0.65	19,000	10	100	7 - 11	<3	B	Sheet	Primer
ES 710	0.40	10,000	37	125	25	2	B	Flake	Top
ES 850	0.26	7,000	30	90	14 - 22	<3	L	Flake	Top
ES 901	0.62	21,000	68	145	4 - 8	<3	L	Pellet	Primer
ES 910	0.45	15,000	65	135	9	<3	L	Pellet	Primer
ES 960	0.30	7,500	18	75	19	<3	L	Flake	Top
HiPES 110	0.40	15,000	110		5	2	L	Pellet	Top

(1) o-chlorophenol @ 35°C

(2) GPC data tested with THF, Relative Standard Deviation ± 10%

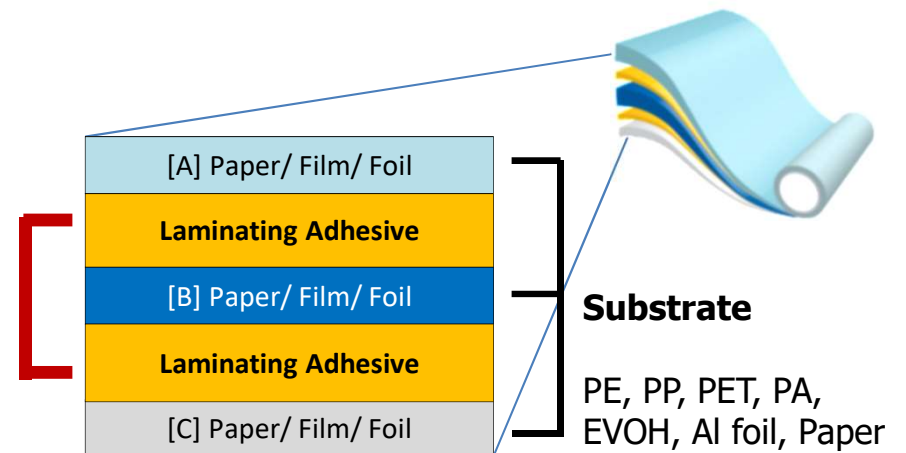
(3) Chemical Structure : L(Linear) B(Branched)

# Main Application – Industrial Adhesive

- ✓ Key Benefit of SKYBON
  - Excellent Adhesion
  - Heat Resistance (Retort)
  - High Flexibility
  - Chemical Resistance
  - Printability as a primer



**Adhesive**  
**PES, PUR, PUD,**  
 reactive PUR Acrylic



- ✓ Key Benefit of SKYBON
  - Excellent adhesion property (glass bead to the substrate)
  - Water resistance
  - Weatherability



- ✓ SKYBON recommendations

Applicable layer	Product	Feature	Benefit
Glass Bead Binder	ES-215	Low Tg High molecular weight	Good wetting, Adhesion Water, chemical resistance
Reflective film adhesion to fabric substrate	EH-601	Hotmelt Film adhesive (Solvent free)	Good adhesion to the fabric Chemical resistance (wash/dry)

## Main Application – Industrial Adhesive\_ Automotive Wheel Coating

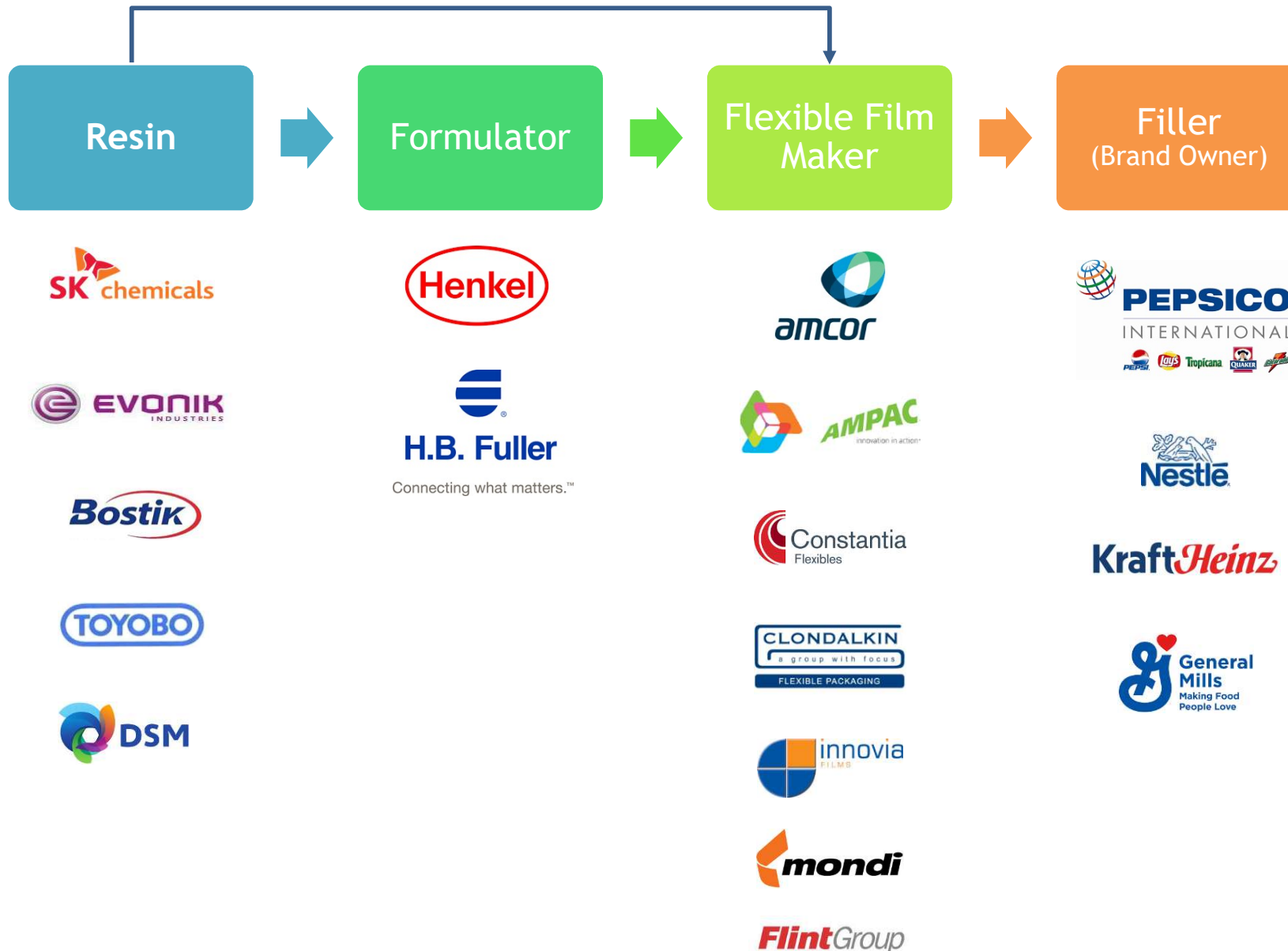
- ✓ Key Benefit of SKYBON, EM
  - Excellent adhesion to aluminum substrate
  - No BPA issue (VOC free)
  
- ✓ SKYBON recommendations



Applicable layer	Product	Feature	Benefit
Primer	EM 360 EM 660	Polyester Emulsion	Excellent water resistance Good adhesion to aluminum substrate

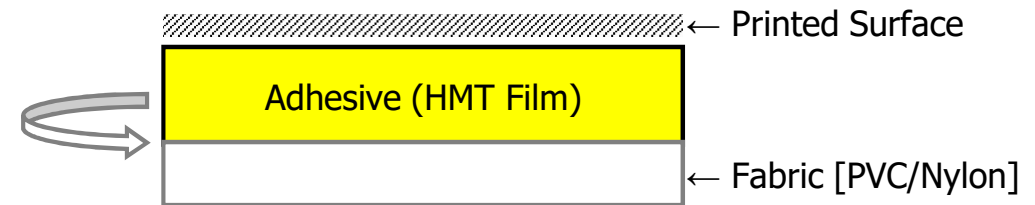
# Main Application – Industrial Adhesive

Most of Flexible Film Makers are doing in-house formulation



# Main Application – Hotmelt\_Fabric adhesive

- ✓ Key Benefit of SKYBON, EH
  - Excellent adhesion to fabric
  - Sew-free adhesion for light weight clothes
  - Chemical resistance (wash/dry)
  - Solvent free
  - Economical vs polyamide, polyurethane

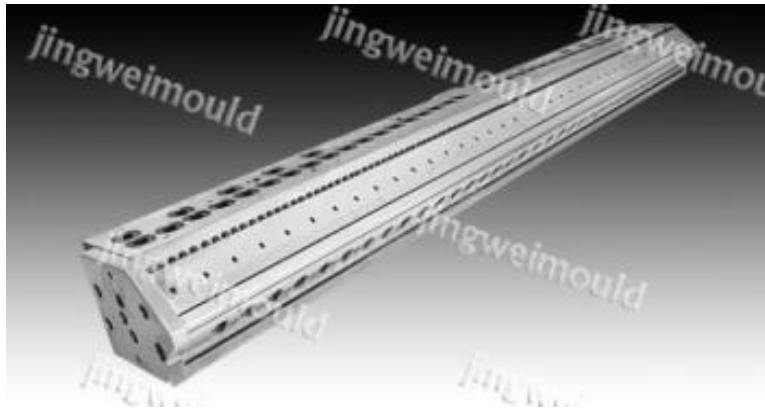


- ✓ SKYBON recommendations (depending on Extrusion temperature)

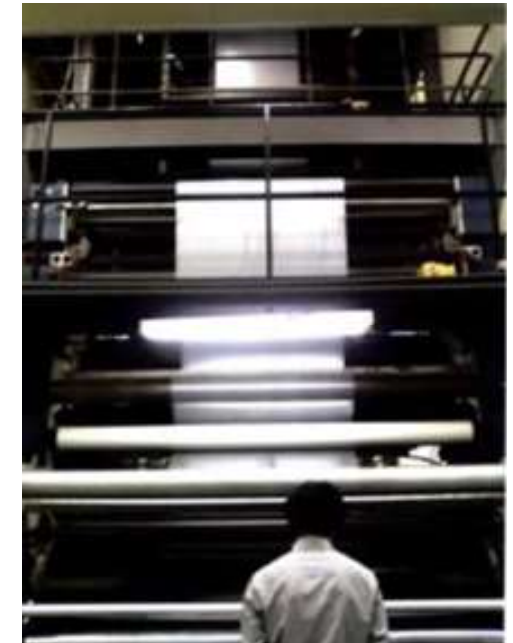
	<b>Product</b>	<b>Tm (°C)</b>	<b>MI (g/10min@160°C)</b>	<b>Benefit</b>
Low Tm	EH 100 EH 700	100	40	Energy saving, Productivity Most widely applicable
Mid Tm	EH 401 EH 601	130	14~20	Chemical Resistance
High Tm	EH 500 EH 550	156~170	24~39	High Heat resistance

# Main Application – Hotmelt\_Fabric adhesive processing

## T-Die extrusion

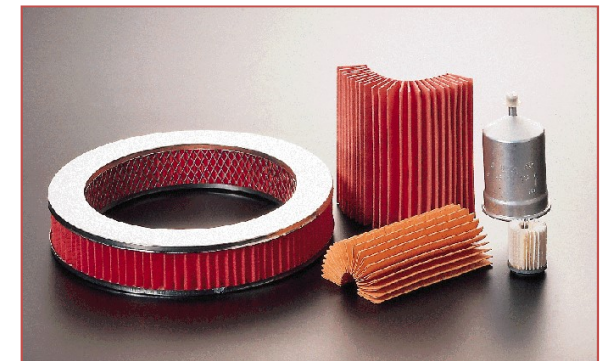
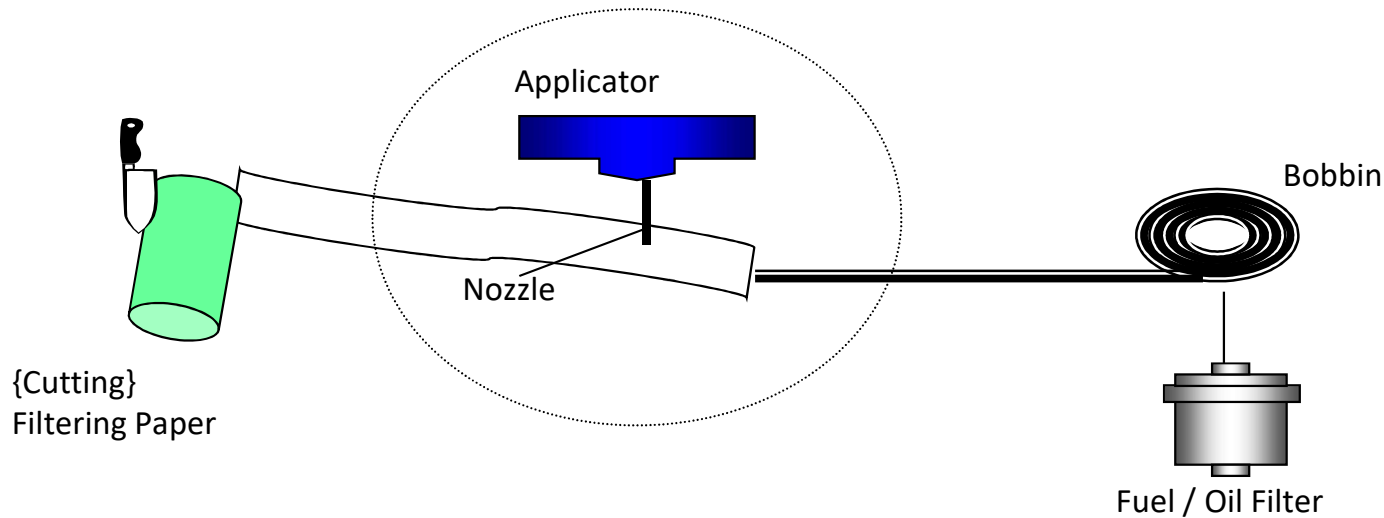
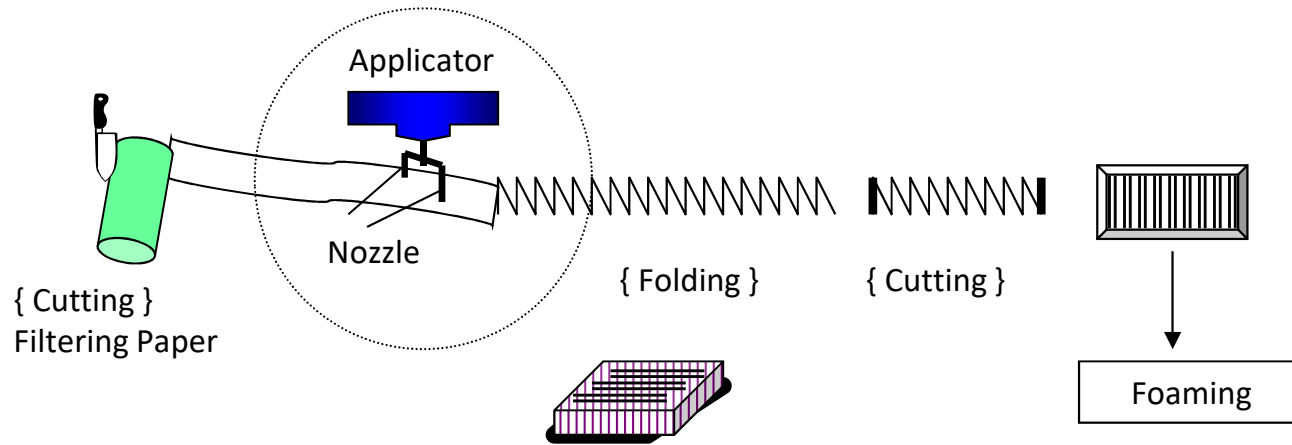


## Inflation process(blowing extrusion)



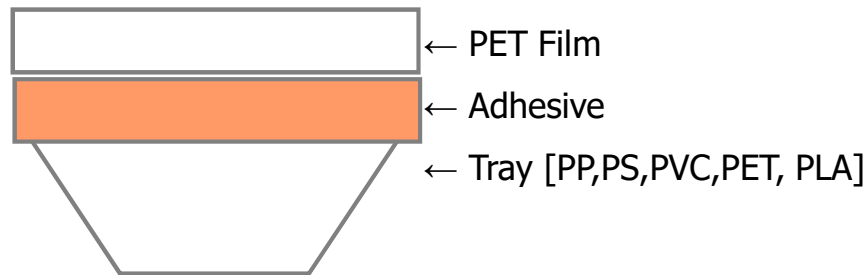


# Main Application – Hotmelt



# Main Application – Hotmelt\_Heat Seal

- ✓ Key Benefit of SKYBON
  - Excellent adhesion to PET film and PET tray
  - Easy peel property from its crystallinity



- ✓ SKYBON recommendations

Processing	Product	Feature	Benefit
Compounding (ES220 + ES250) to control the easy peel property	ES 220	Low Tg, Semi-Crystalline	Adhesion property
Then, extrusion into hotmelt film on to substrate	ES 250	High Tg, Semi-Crystalline	Easy peel property



Heat Transfer Film



Automotive Filter



Lidding Film



# SKYBON application

Appliance



Packaging



Adhesive film



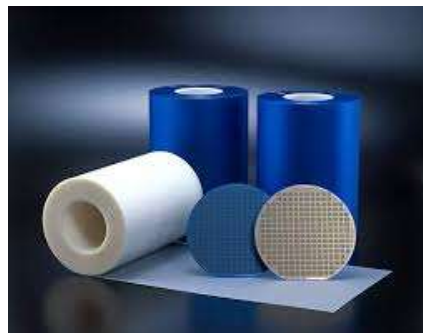
wiseGEEK

# SKYBON application

Industrial



Electronics



# SKYBON application

Sizing Agent



Paper Coating



# SKY BON<sup>®</sup> EM

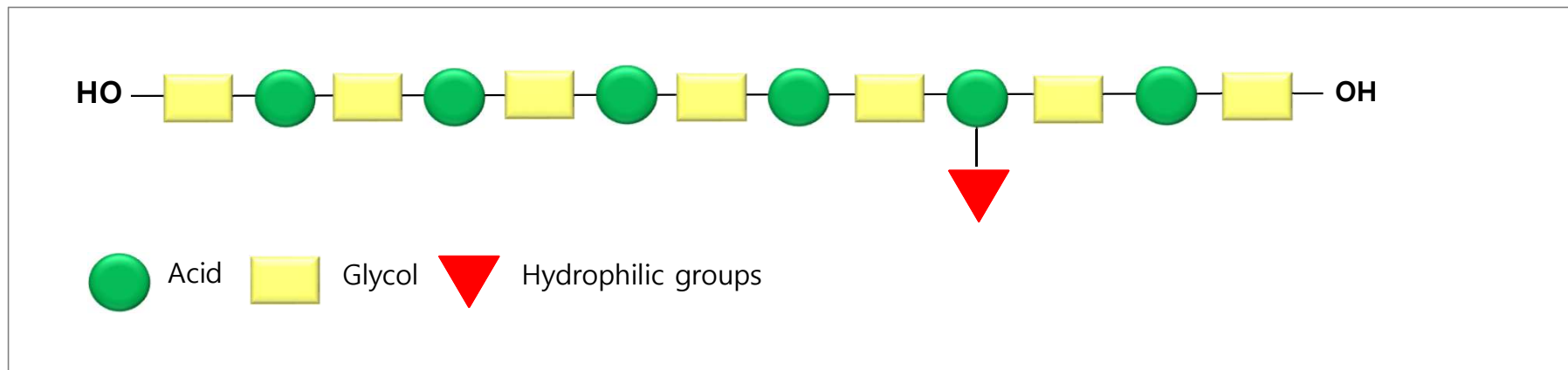
THERMOPLASTIC SATURATED COPOLYESTER EMULSION

## Introduction of EM

### ✓ Water-borne co-polyester in SKYBON

- Water-borne polyester is readily dispersed in water without surfactant or amine
- Types: **EW** (water dispersion polyester)  
**EM** (emulsion polyester)

### ✓ Simplified chemical structure of water-borne polyester





# Advantages

## ✓ Benefits

- No surfactant is needed
- Amine or ammonium free (low odor)
- Excellent water resistance
- Excellent storage stability
- Uniform & narrow particle size distribution
- Relatively low viscosity at a high solid content

## ✓ Emulsion polyester vs. water soluble polyester

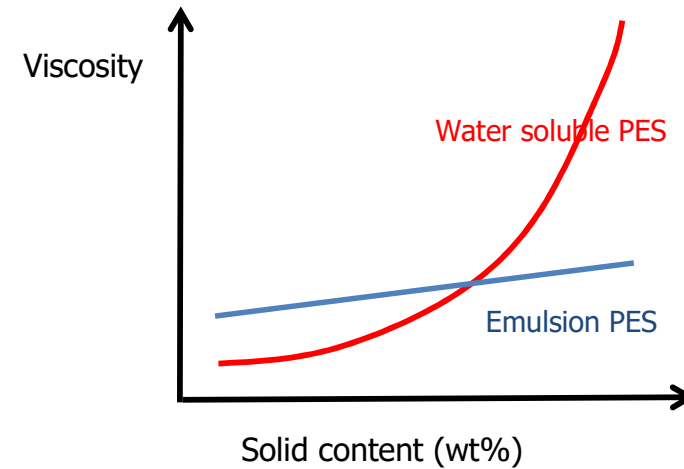
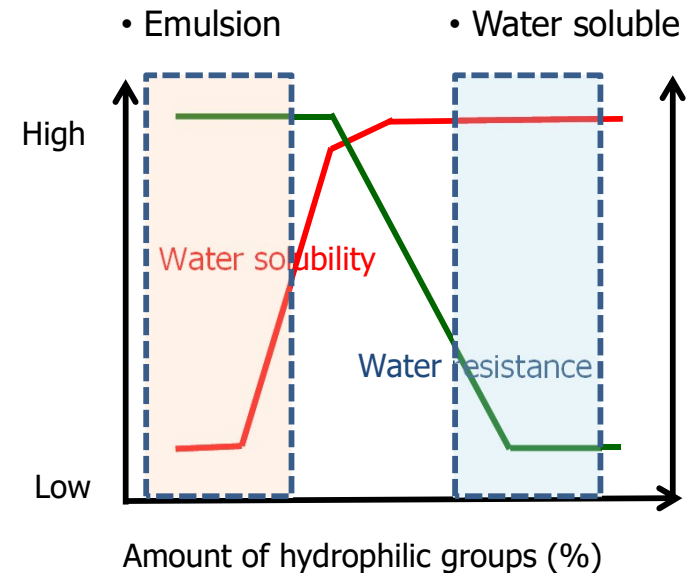


Image source: freeimages.com



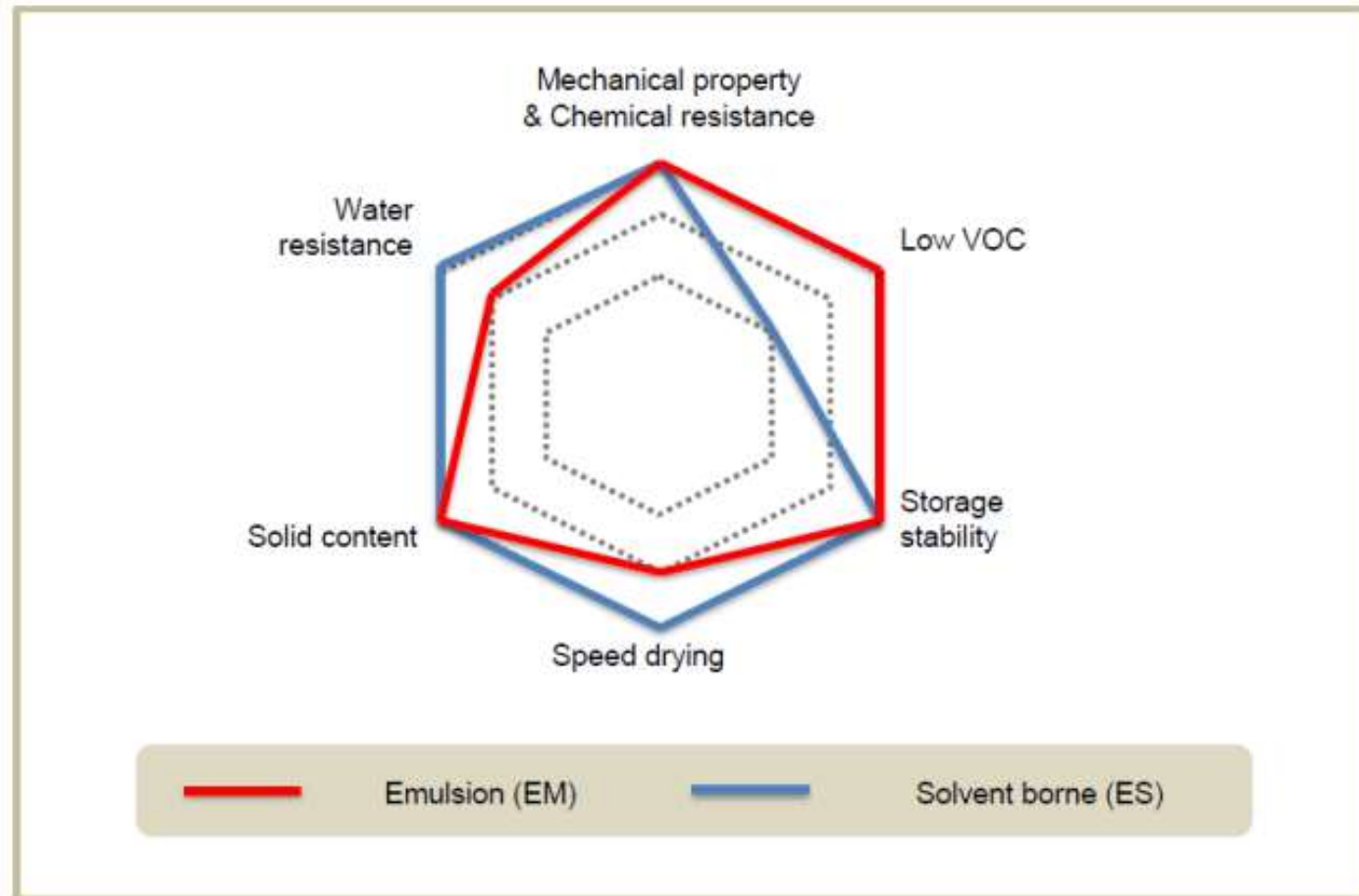
## Product Line Up

### ✓ Typical characteristics of EM

Property	unit	EM 110	EM 360	EM 410	EM 660
Solid content	wt. %	45	40	45	45
Appearance	-	Milky white			
Particle size	nm	110 ~ 170			
Viscosity	cps	< 2,000			
Intrinsic viscosity	dl/g	0.53	0.68	0.50	0.45
Molecular weight (Mn)	g/mol	18,000	20,000	17,000	16,000
Tg	°C	<b>65</b>	<b>17</b>	<b>47</b>	<b>70</b>
Acid value	KOH mg/g	< 3	< 3	< 3	< 3
Hydroxyl value	KOH mg/g	3~6	1~5	3~6	4~6

# Performance comparison

## ✓ Comparison by type of polyester



# Coating Performance of EM

## ✓ Polyisocyanate curing system

Curing condition: 20minute @140°C

Step	Process	Recommended materials	wt%	Remarks
1	Put SKYBON EM into a vessel	EM (supplied form)	80~95	
2	Slowly drop the diluted RM-825 with strong agitation for 10~15 minutes	RM-825 <sup>1)</sup> 50% in water	~1.5	The use of diluted thickener exhibits enhanced stability
3	Add cross-linking agent with continuous agitation for 10 minutes	Bayhydur BL XP 2706 <sup>2)</sup>	5~10	Deblocking temperature 20min @ 140°C or 15min. @ 150°C
4	Add deformer if needed	-	~1	
5	Add co-solvent according to the needs	Butyl carbitol	~10	Co-solvent and leveling agent are recommended for good coating appearance
6	Add leveling agent	-	~1	

(1) Dow

(2) Covestro

# Guide Formulation and Curing for SKYBON EM

## ✓ Melamine-formaldehyde curing system

Curing condition: 15minute @160°C

Step	Process	Recommended materials	wt%	Remarks
1	Put SKYBON EM into a vessel	EM (supplied form)	80~95	
2	Slowly drop the diluted RM-825 with strong agitation for 10~15 minutes	RM-825 <sup>1)</sup> 50% in water	~1.5	The use of diluted thickener exhibits enhanced stability
3	Add cross-linking agent with continuous agitation for 10 minutes	Cymel 328 <sup>2)</sup>	5~20	
4	Add deformer and DMEA if needed	-	~1	
5	Add co-solvent according to the needs	Butyl carbitol	~10	

(1) Dow  
(2) Allnex

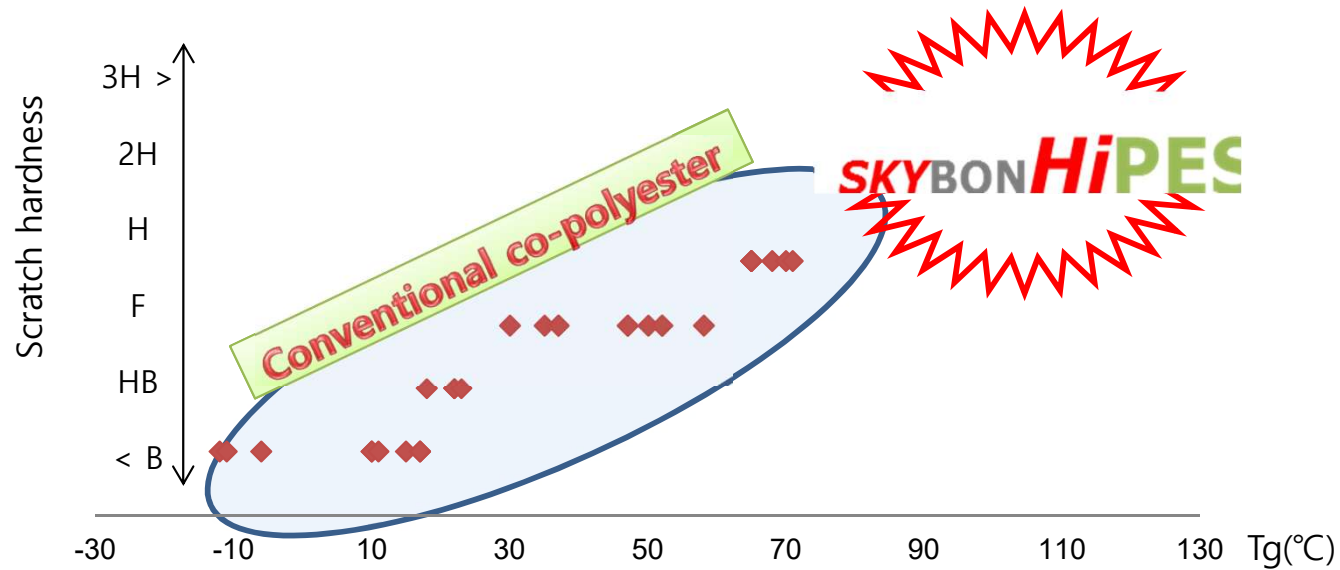
# **SKYBON** *Hi* **PES**

Heat Resistance Polyester



# Introduction of HiPES

HiPES is a saturated amorphous copolyester which has high Tg and well-balanced properties such as superior heat resistance/hardness and sufficient solubility for solvent-based application



## Target application

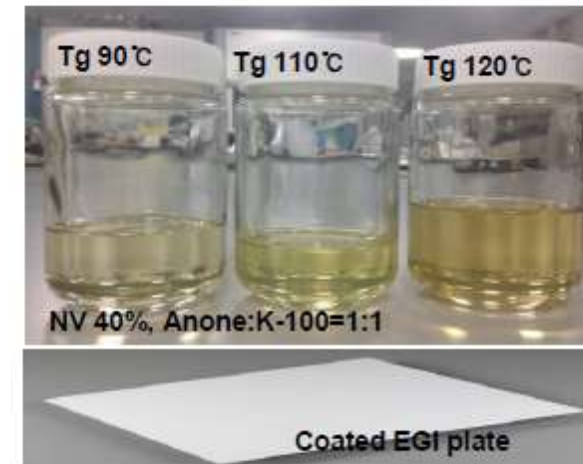
- IMD/IML
- Window film
- Solar cell Back-sheet
- Metal Coatings



# Introduction of HiPES

## ✓ Features of HiPES

- Excellent **heat resistance** and **scratch hardness**
- Good **chemical resistance**
- Suitable **solubility** for industrial solvent
- Well-balanced properties for solvent-based application



## ✓ Properties of HiPES

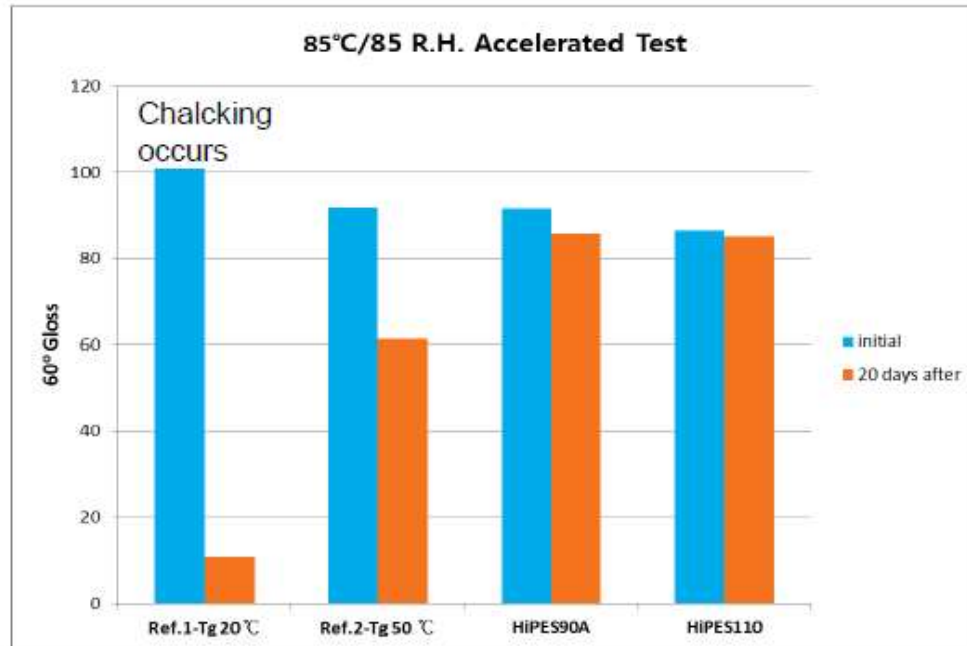
No.	IV (dl/g)	Tg (°C)	OHv (mgKOH/g)	Av (mgKOH/g)	Solubility(N.V 40 wt%)				
					DBE <sup>1)</sup> 100 %	Anone <sup>2)</sup> :K-100 50:50 %	MEK:Toluene 50:50 %	MEK 100 %	EA <sup>3)</sup> 100 %
HiPES 90A	0.45	92			O	O	O	O	X
HiPES 90B	0.45	87	8 ~ 12	<3	O	O	O	O	O
HiPES 110	0.40	110			O	O	O	X	X
HiPES 120	0.36	120			O	O	O	X	X

1)DBE=Dibasic ester 2)Anone=Cyclohexanone 3)EA=Ethyl acetate



# Performance Test – 85 °C / 85% R.H Humidity acceleration

✓ **HiPES 110 & 90A show excellent heat and humidity resistance.**



※ Formulation(white coat)

- Solution : NV 40%, Anone:K-100=1:1

- Mill base : Pigment/Resin=1.2

BYK-110 1.5%

- Let down : X-linker(Cymel303)/Resin=1/6

Catalyst(Cycat500) by binder=2%

BYK-355 0.5%



**<White top coat samples after 20 days humidity acceleration test>**

## Field of applications – Metal coating (Pre-coated metal)

### ✓ Top white coating for refrigerator door

Property	HiPES 110
Tg(°C)	110
Thickness (μm)	25
Gloss(60°)	91 %
<b>Pencil hardness</b>	<b>H</b>
<b>PE bag corrosion resistance (Max 5)</b>	<b>4++</b>



Image source: new.samsung.com

※ PE bag corrosion  
: Decrease in gloss by adhesive contamination of protective PE film

