

Basic property of Plastics

Physical property ASTM	Unit	PVC (Hard)	PE (HDPE)	PP	PS
Gravity D792	—	1.35–1.45	0.94–0.97	0.90–0.91	1.03–1.06
TS (拉伸) D638 Break	MPa	34–62	22–38	29–38	34–82
TM (延展) D638	GPa	2.5–4.1	0.4–1.1	1.1–1.6	2.7–4.1
Compressive S D695(壓縮)	MPa	55–89	19–25	38–55	82–89
HDT(熱變形) D648 18.6Kg/cm ²	°C	54–80	43–49	57–64	>104
T _g (玻璃轉化溫度)	°C	82	–125	–20	100
Limit Oxygen index	%	45–49	17.4	17.4公	17.6–18.3
Oxygen Permeability	mg/ m ²	3.65	50–205	104	189
Usual heat resistant T	°C	60–80	90–110	100–140	70–90

PE/PP processing easy, Poor dimensional stability,
PS Poor oil and chemical resistance

revision 12.19 2022
Edited by Ken Su



Formosa Plastics MBS / PA Advantages

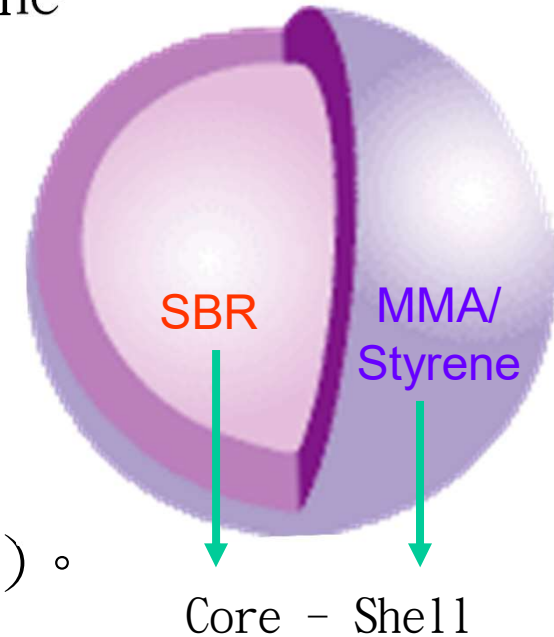
- 1. NAN YA Plastics provides processing experience, new product test data provides technology research and development direction, continuous innovation process, and greatly enhances product stability.**
- 2. Formosa Plastics R&D team has the ability to develop its own technology and continuously develop new products and upgrades. quality.**
- 3. Formosa Plastics in the supply of raw materials, vertical integration vertically, with cost advantages .**



MBS Impact modifier characteristics

1. MBS Product name is named by the composition of raw materials
MMA(Methyl-meth-Acrylate)-
Butadiene-
Styrene Copolymer ◦

2. MBS structure is SBR rubber
Grafted MMA and Styrene
Core-Shell copolymer (pictured) ◦



3. Core Structure and characteristics

Butadiene : The Tg temperature is -80°C , which is an elastic substance, Can provide low temperature impact ◦

Styrene : Adjust the RI value to make the modifier and PVC matches, avoid reducing the transparency of the plastic.



4. Shell Structure and characteristics

monomers are usually acrylic esters such as PMMA:

- (1) The rigid structure can effectively cover the core and make the modifier can be powdered
- (2) distribute the modifier in the plastic and promote the gelatinization of the plastic.

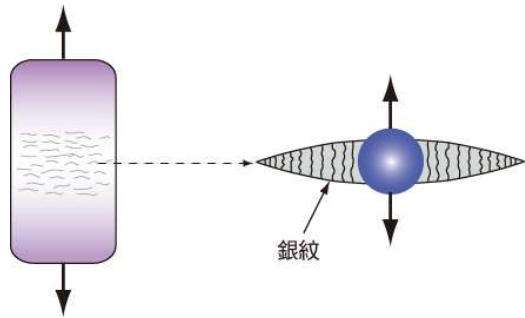
5. Why use MBS impact modifier for plastics

- (1) Before most plastics are modified, they are a brittle substance at room temperature.
- (2) Even engineering plastics at low temperature too.
- (3) Usually can added elastomers, but The amount and compatibility with plastic affect the transparency.



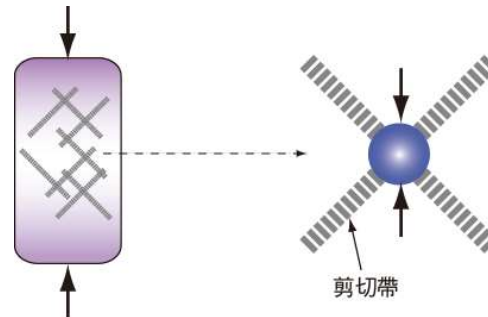
MBS Modifier Principle

- 銀紋
Silver grain



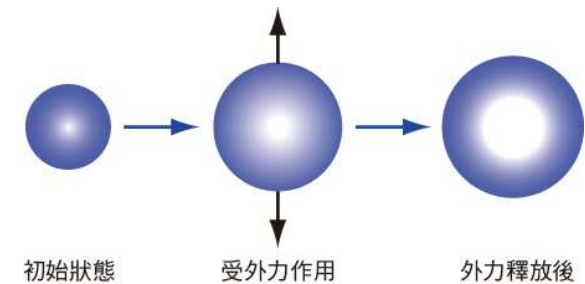
- When the external force is released, and a silver grain is formed to prevent crack formation to achieve a toughening effect.

- 剪切屈服
Shear yielding



- MBS is subjected to stress, the shear band with micro-shear deformation is formed at an angle of 45 degrees around the MBS to consume energy.

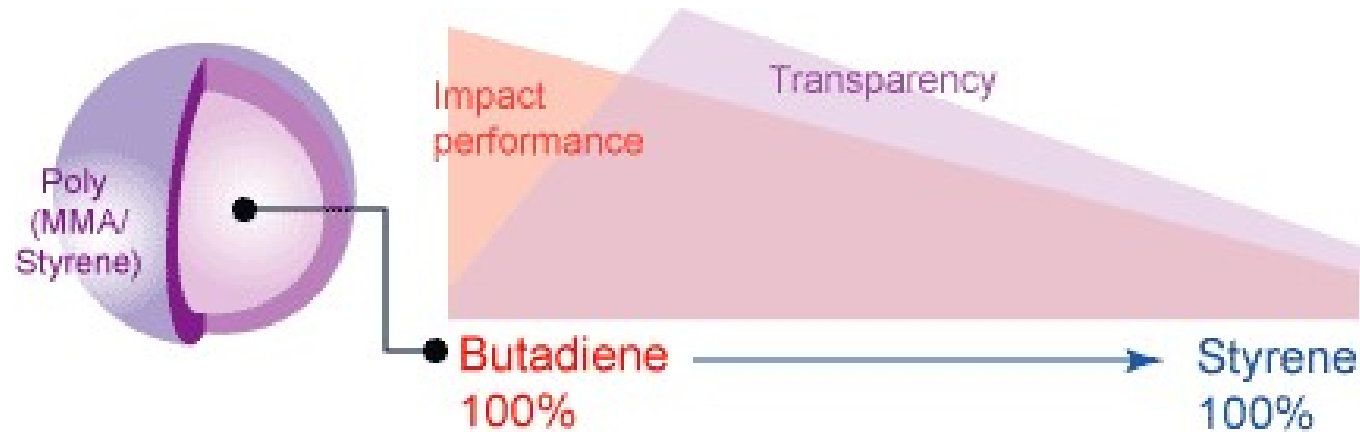
- 空洞化, 白化
Hollow, whitening



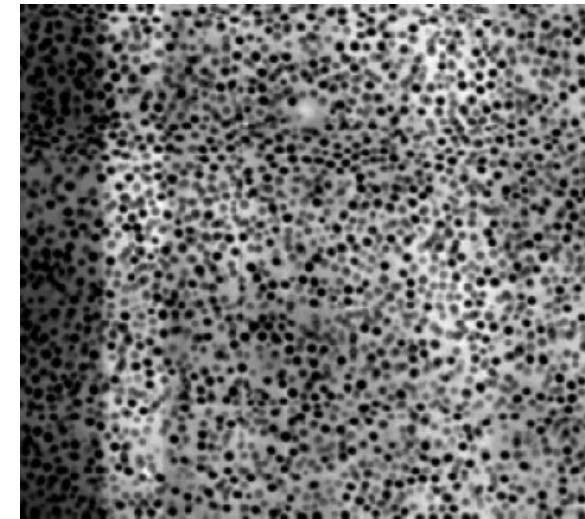
- MBS becomes an energy absorption center, the core becomes a permanent cavity and becomes a whitening phenomenon.



6. the ratio of Bd-SM in SBR VS impact and transparency



7. MBS particles are nano-scale,
The particle size is about
50~200nm, By TEM
MBS will be evenly
distributed in PVC.

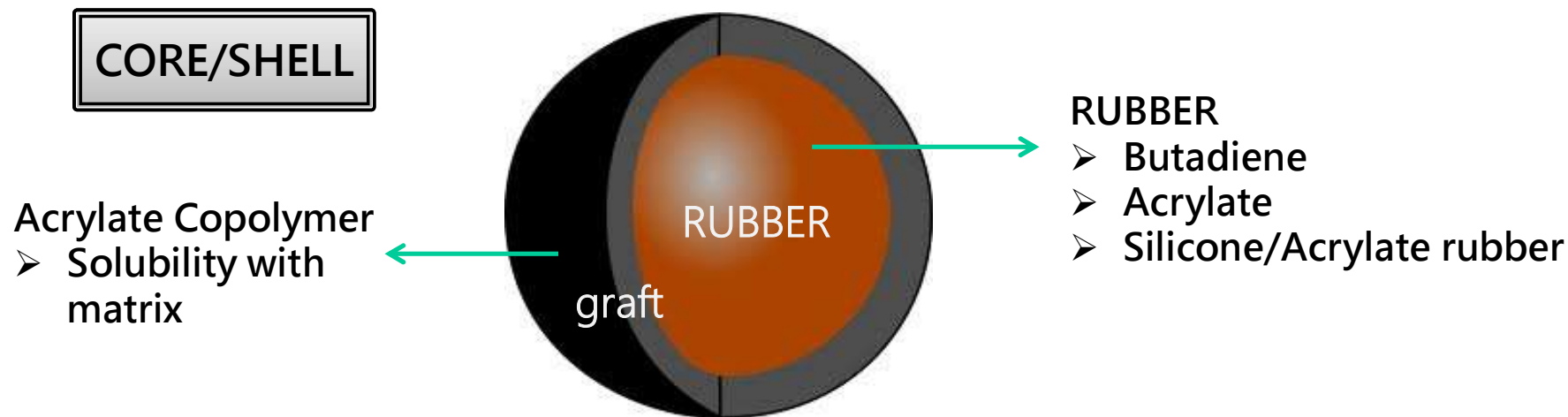


1 μ



改質劑構造 Impact modifier Structure

FORMOLON

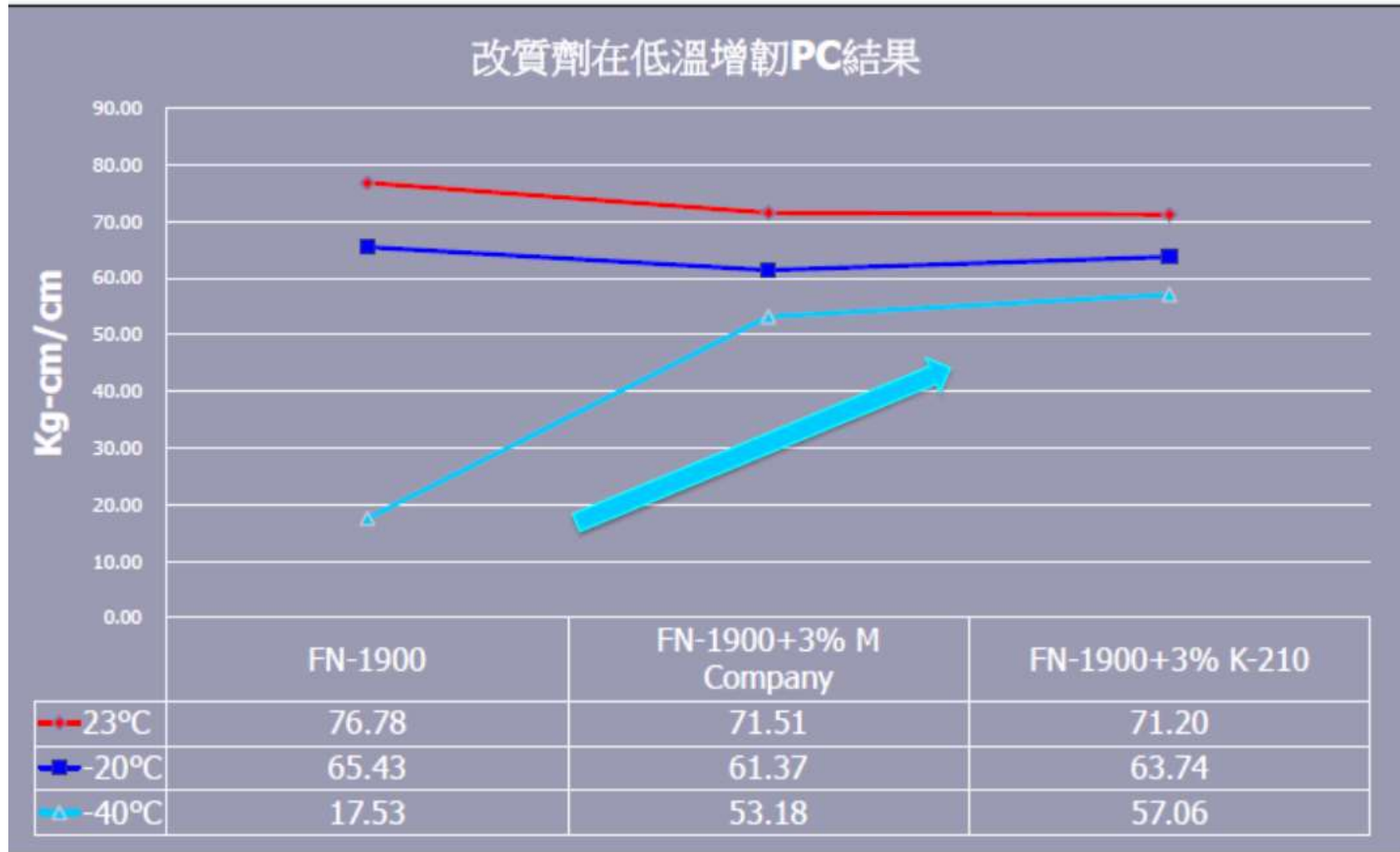


	RUBBER	RUBBER property		Weather resistance
		R.T.	L.T.	
M-TYPE	Butadiene	○	○	×
A-TYPE	Acrylate	○	△	○
K-TYPE	Silicone/Acrylate	○	⊙	⊙

Excellent → Bad : ⊙ > ○ > △ > ×



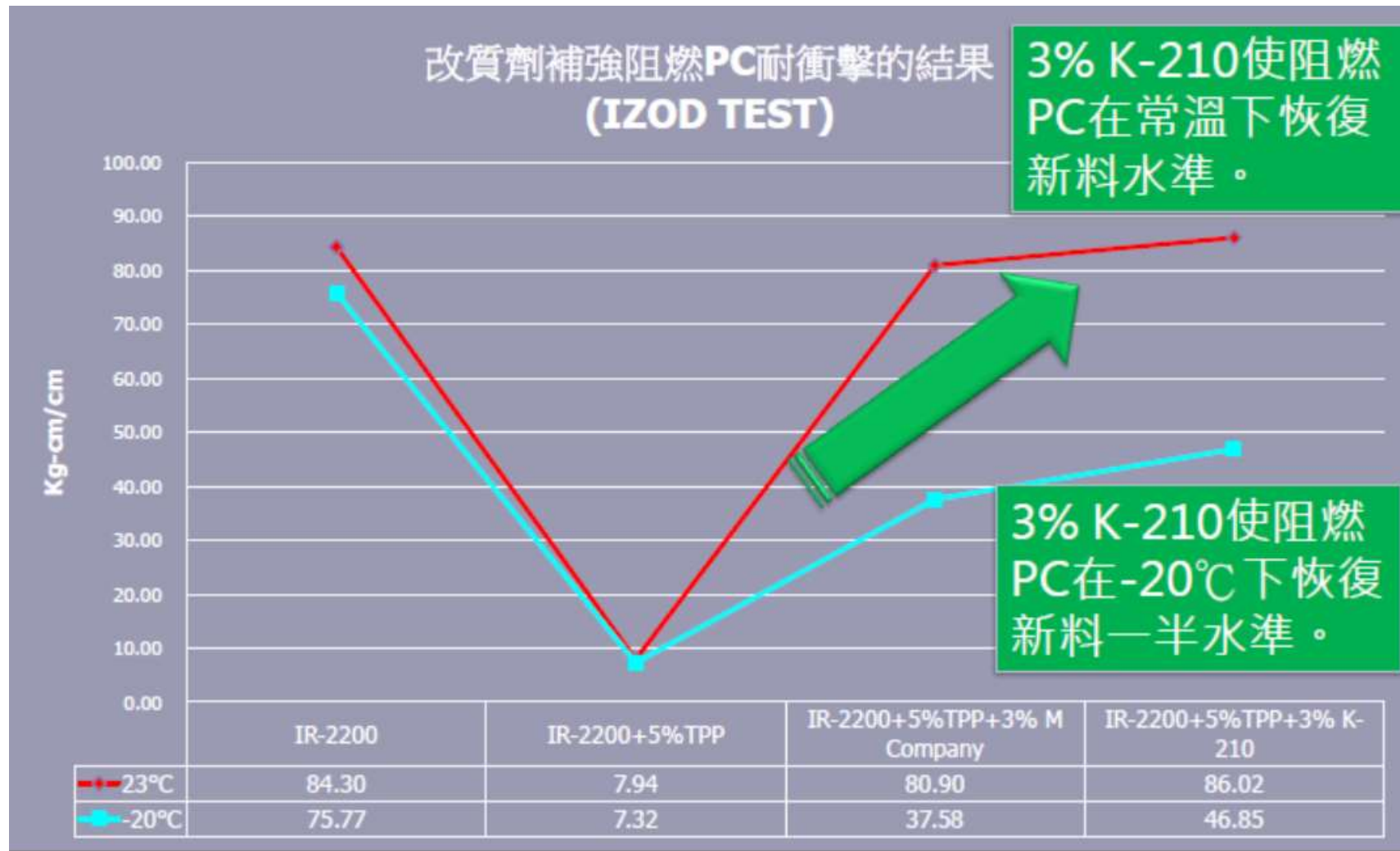
When to use modifier: low temperature



At -40°C, the impact is decreases to 17 (blue)



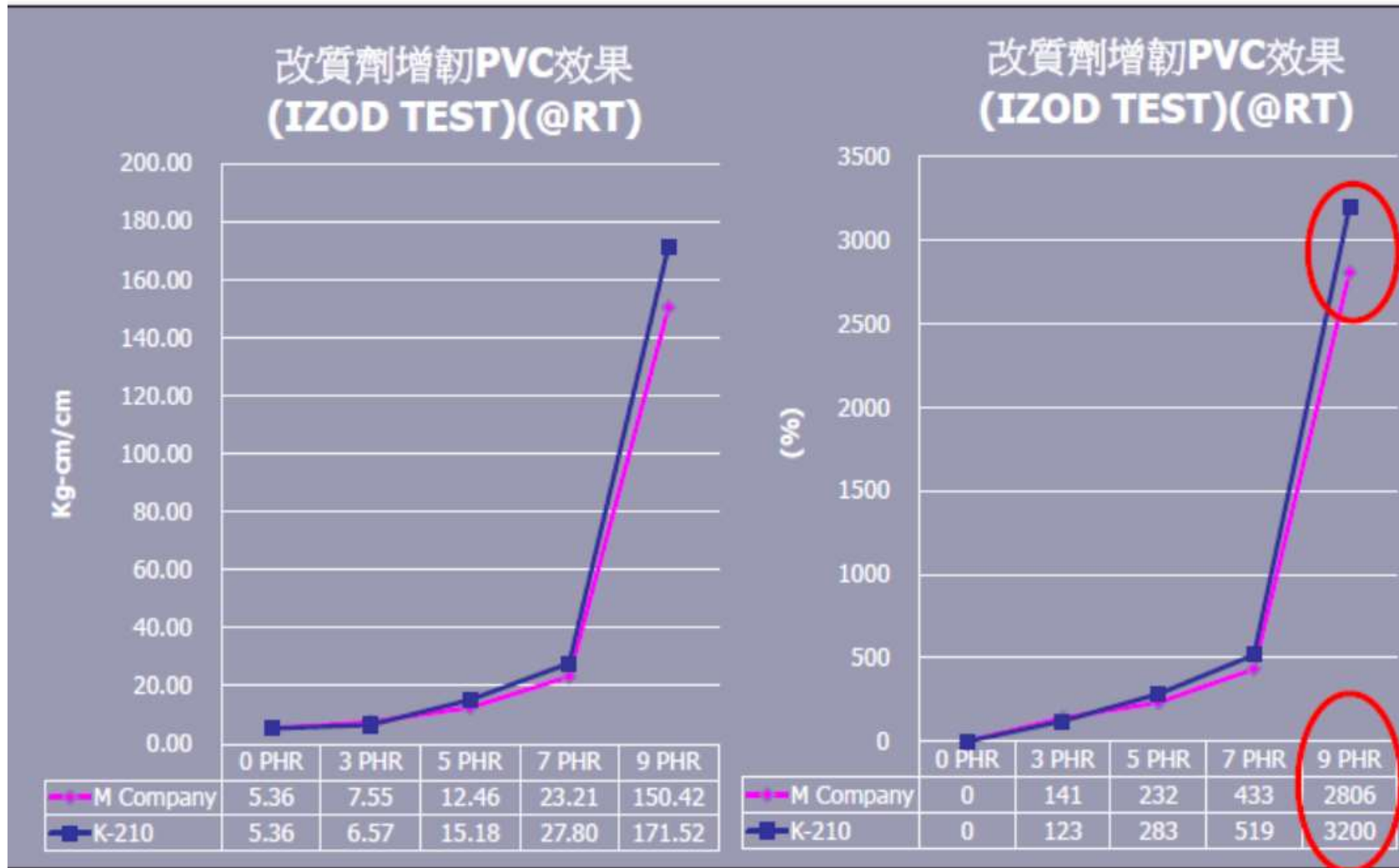
Timing : When the additive destroys the impact strength



When flame retardant is added, the impact is reduced to 9 (red)



Timing of modifier: weak material

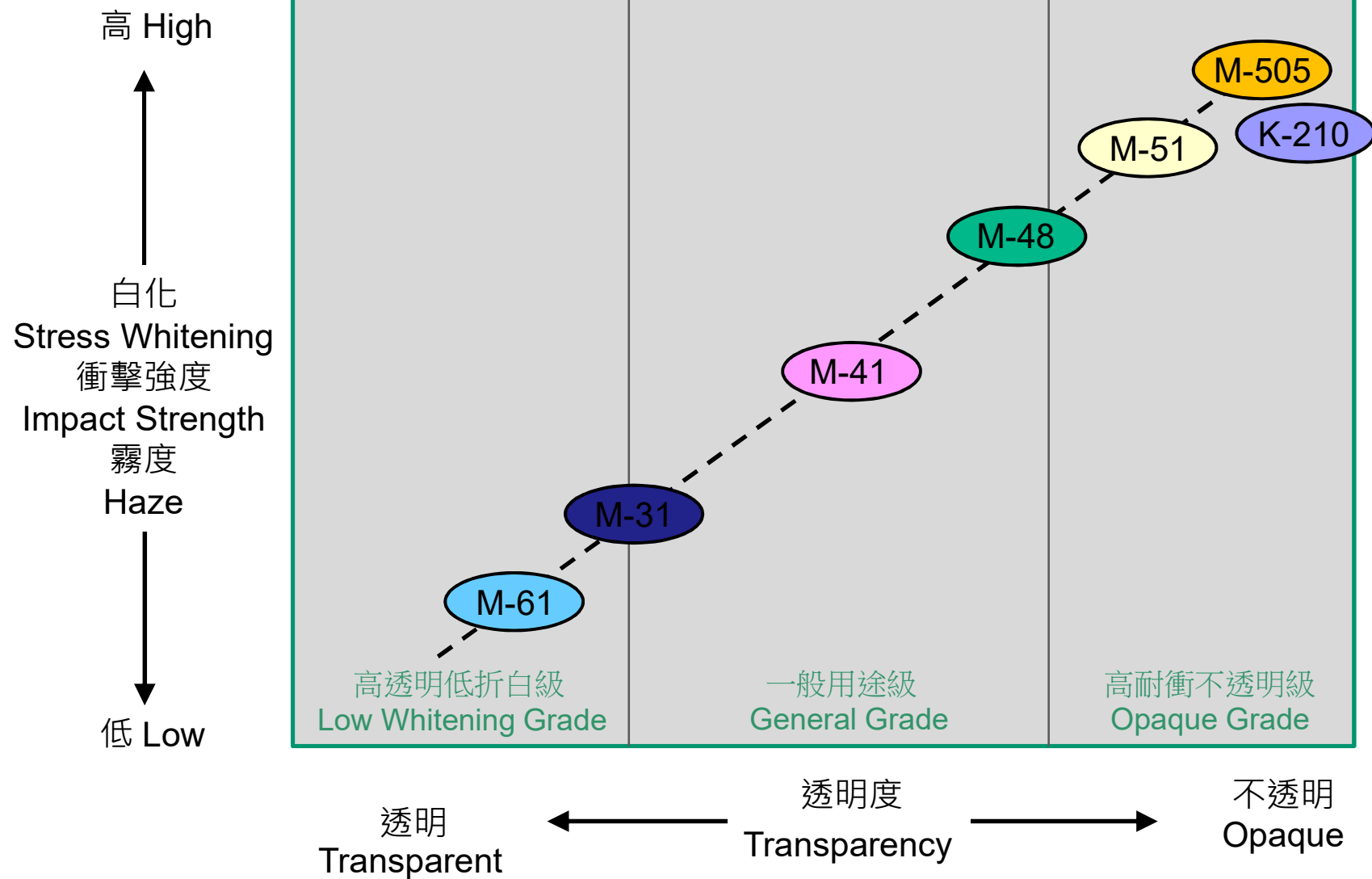


Add 7~9 PHR to get the best impact strength



FORMOLON MBS的分類 Classification of FORMOLON MBS

FORMOLON MBS



Introduction of products of MBS (1)



Grade: M-31

Features: high transparency and anti-folding white

Uses: shrink film, folding box, medicine packaging material

Grade: M-41

Features: general transparent use impact resistance

Uses: credit cards, wood floors, Medical face masks

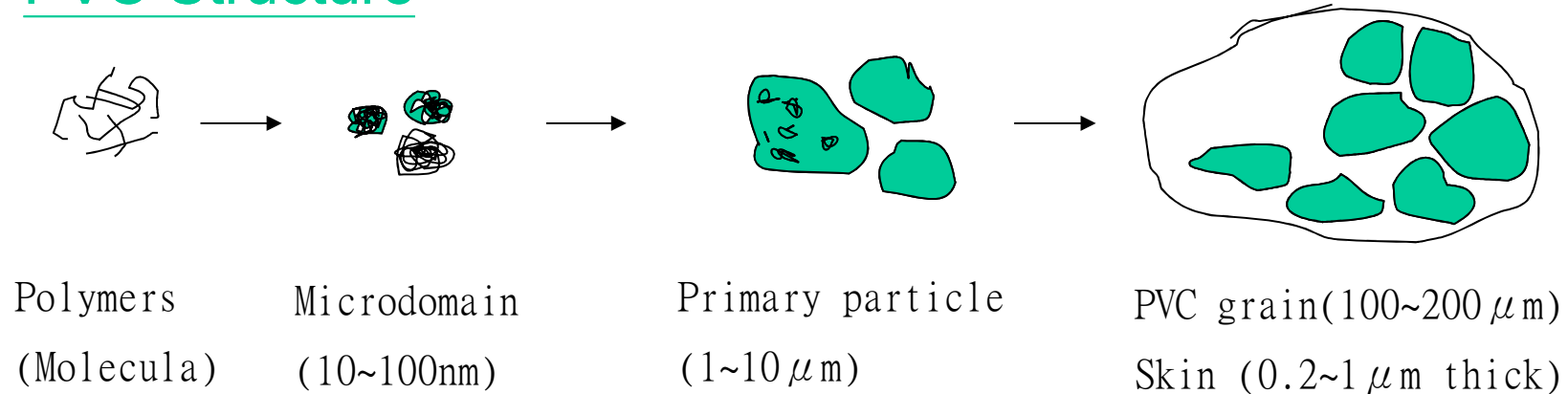
Introduction of products of MBS (2)

	
Grade: M-51 Features: opaque and high impact Uses: Christmas trees, building materials, complex pipe fittings	Grade: K-210 Features: high impact can be used for engineering plastics Uses: metal dyeing plate, 3C shell



MBS/PA has function of PVC plasticization

PVC Structure

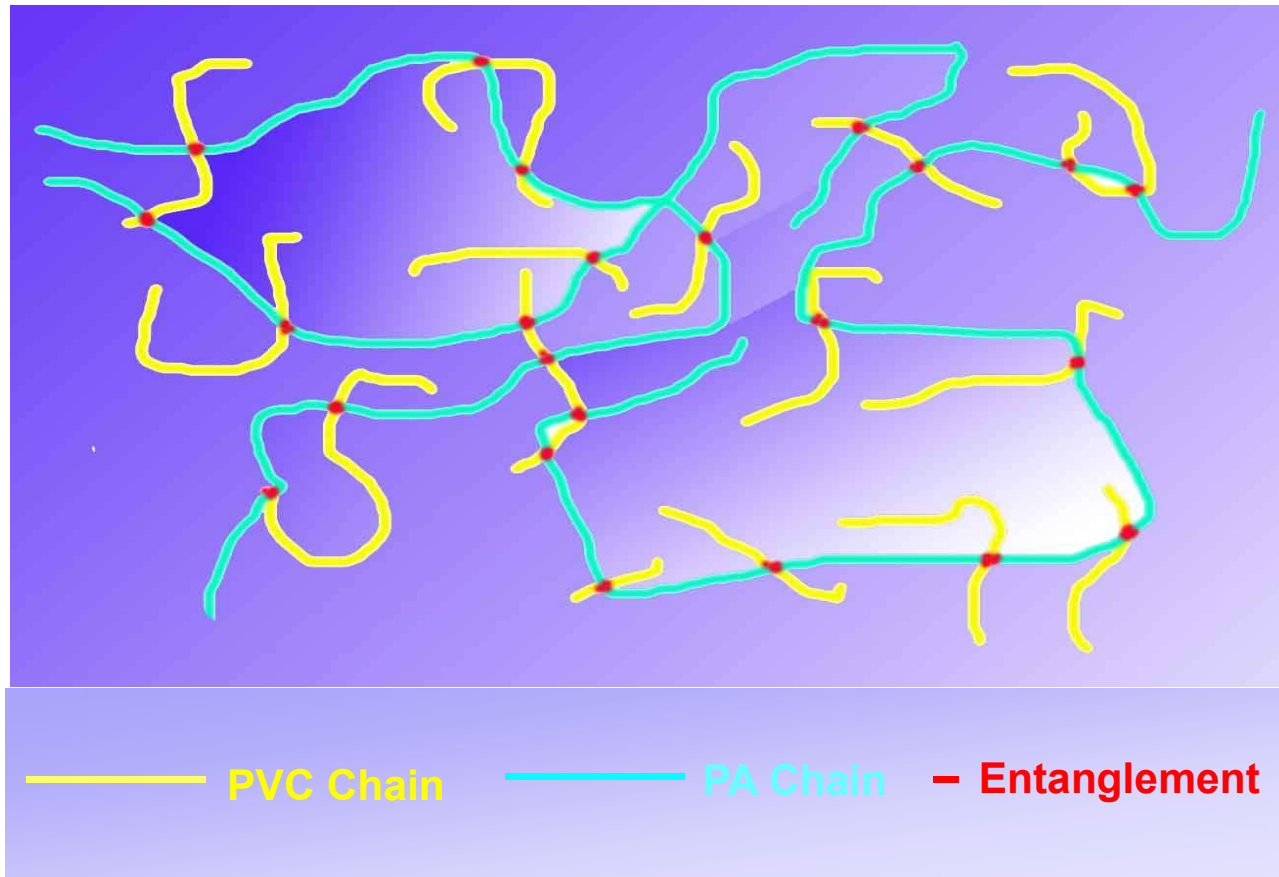


PVC particles have a hard skin,
which makes gelation difficult.

- PVC processing through heat and shear cut
- MBS / PA is a polymer additive that provides PVC gelation. They play a role in transferring heat and shear.



PA Improves melt strength



- PA chain **Entanglement** PVC chain
- PA molecular chain is long and flexible ,
Elastic and Extension

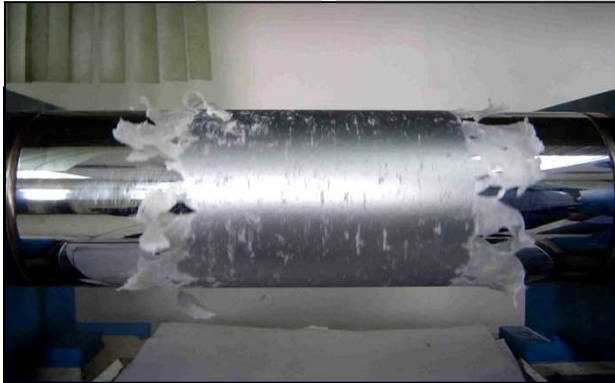


Processing aids類型與應用 (Type and application)

	分子量 Molecular weight	類型 Type	Matrix Resin			應用 Application
			ABS	PVC	CPVC	
P-101	低 Low ↑ ↓ 高 High	滑劑型 Lubrication type	○	○		· 高分子外部滑劑 Exterior lubricant
P-1000		高效率滑劑型 Ultra High efficiency Lubrication type	○	○	○	
P-201		一般膠化型 General type		○		· 硬質、半硬質輥輪 for rigid,semi-rigid calender · 押出 extruding · 吹瓶 blow-molding · 射出 injection-molding
P-220		一般膠化型 General type (減少析出 reduce plate out)				
P-251		快速膠化型 Fast gelation type		○	○	· 收縮膜 shrinking film · 射出 Injection molding
P-301		高效率分散型High efficiency dispersion type	○	○		· 硬質、半硬質輥輪 for rigid,semi-rigid calender · 押出 extruding · 吹瓶 blow-molding · 射出 injection-molding · 二次加工 second-processing · 發泡 foam-molding
P-302 P-701		超高效率分散型 Ultra High efficiency dispersion type	○	○		
PA help the processing range more wide and easier to control.						



PA Promote Plasticization



Not easy to plasticize



Plasticize is Better



Bank Accumulation

NO PA added



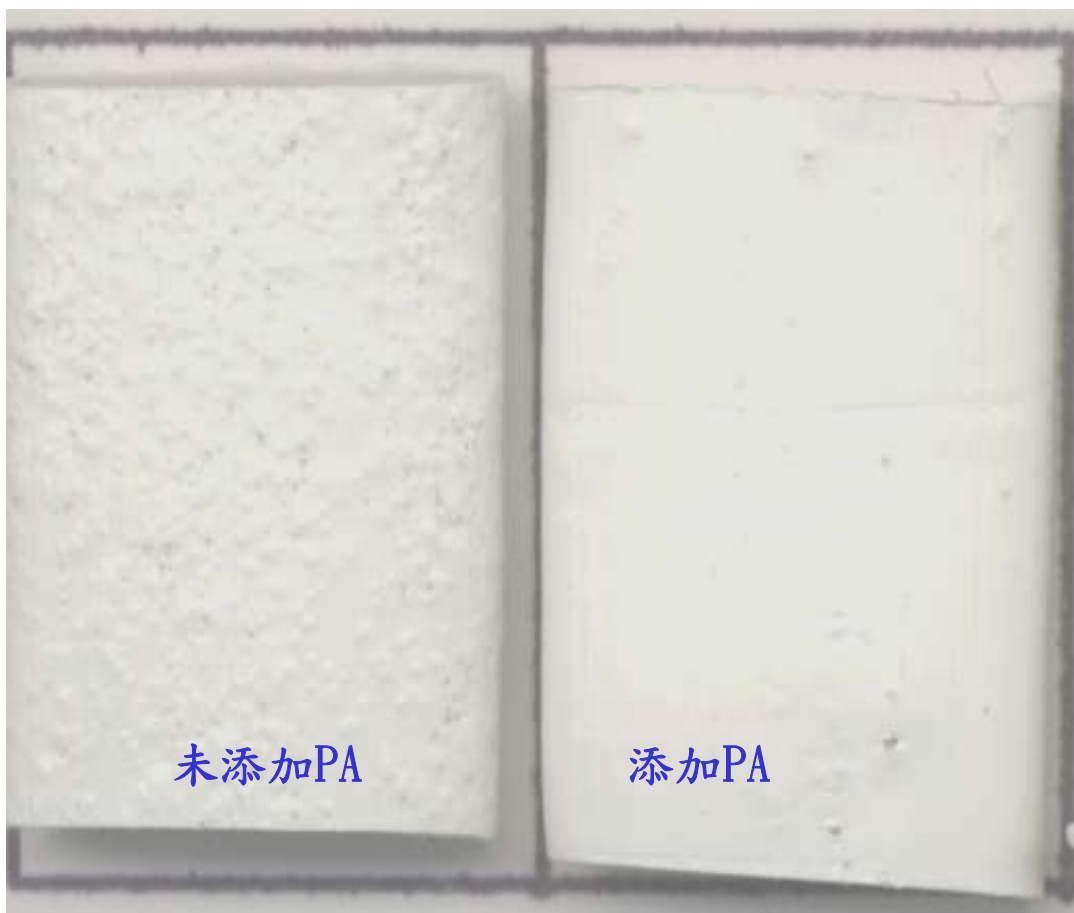
Fluidity is Better

PA added



P-201 Character

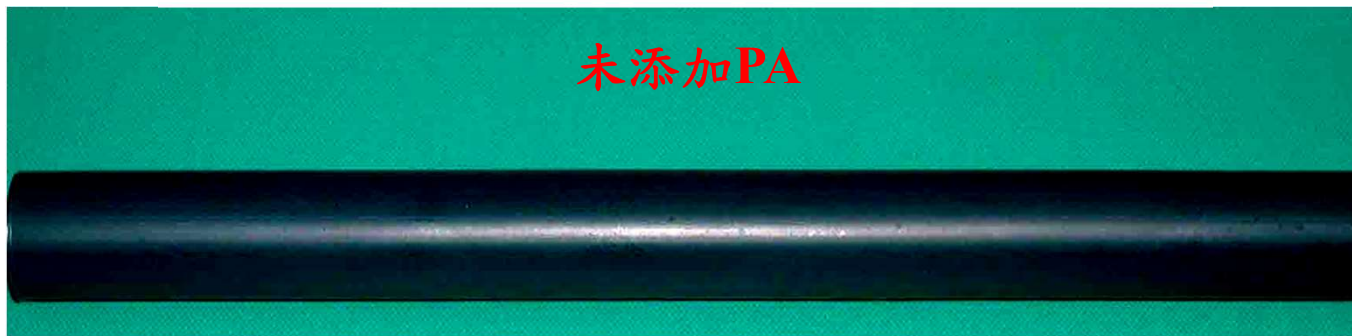
Adding PA to make product surface look flat



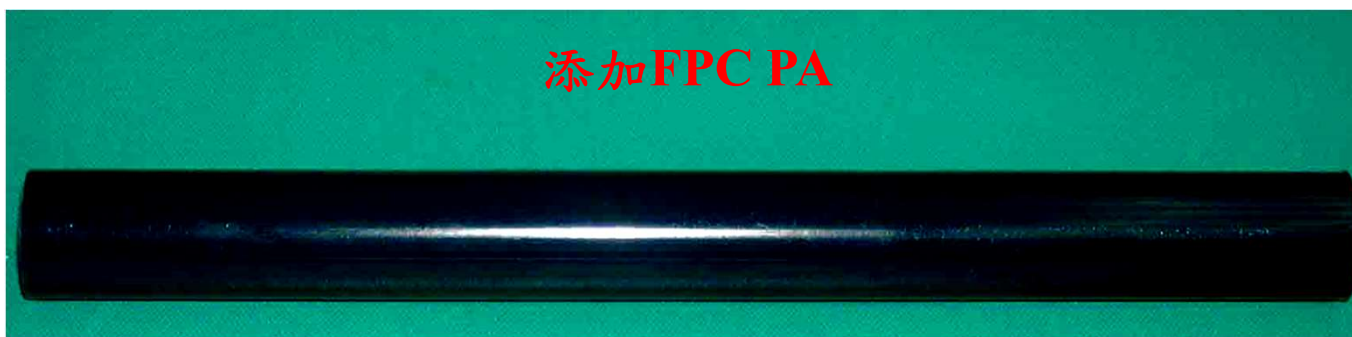


PA promote product gloss

未添加PA

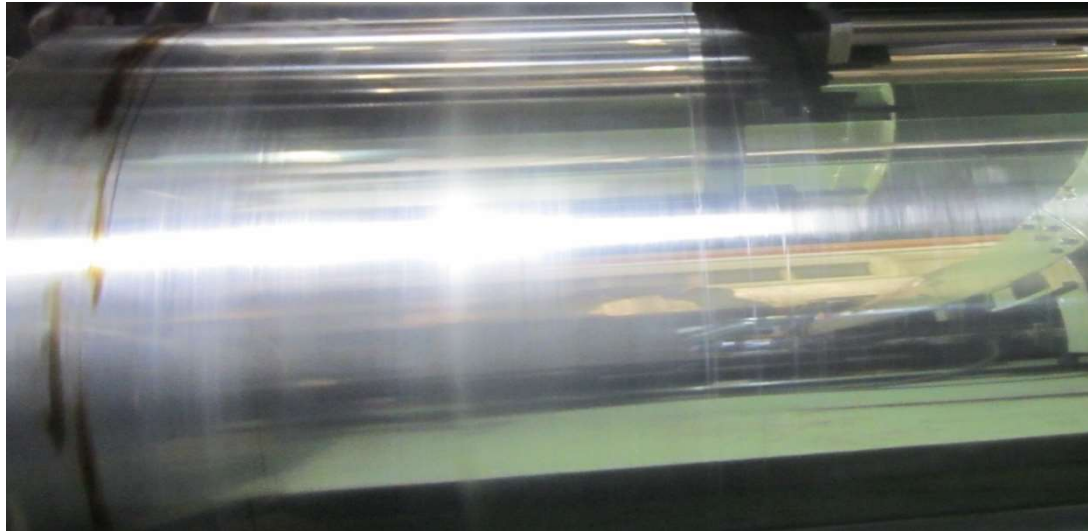


添加FPC PA





P-220 Improve plate-out



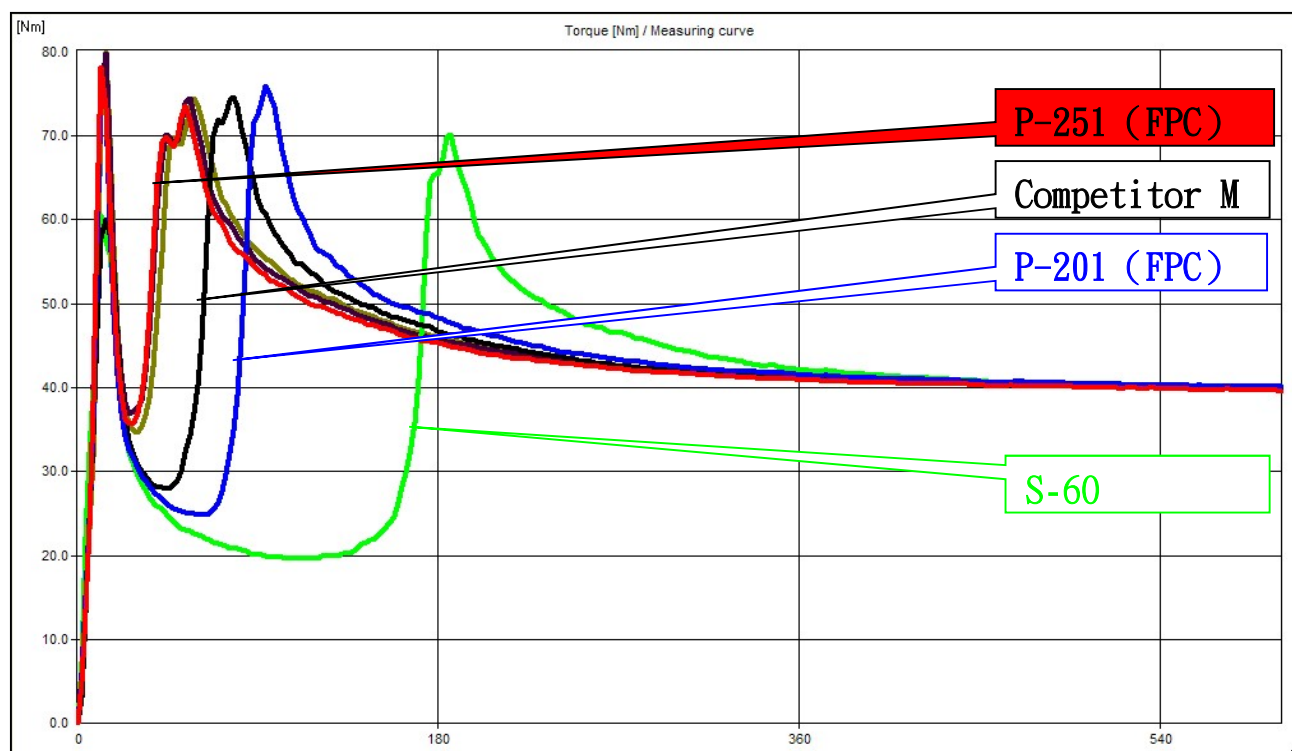
- The surface of the calendar appears plate-out by the long-term operation, account the quality and avoid the roller coated, It needs to stop.
- P-220 with self-cleaning effect and reduce the frost. calendar can keep clean. The process can be continuously produced for a long time



P-251 Promote plasticized

Character :

- 1 、 Gelatinization is fast(short time)
- 2 、 Fish eye is less
- 3 、 Transparency is good
- 4 、 Tension and elongation are better



Comparison of soft PVC gelation difference



Figure 1: Incomplete gelation

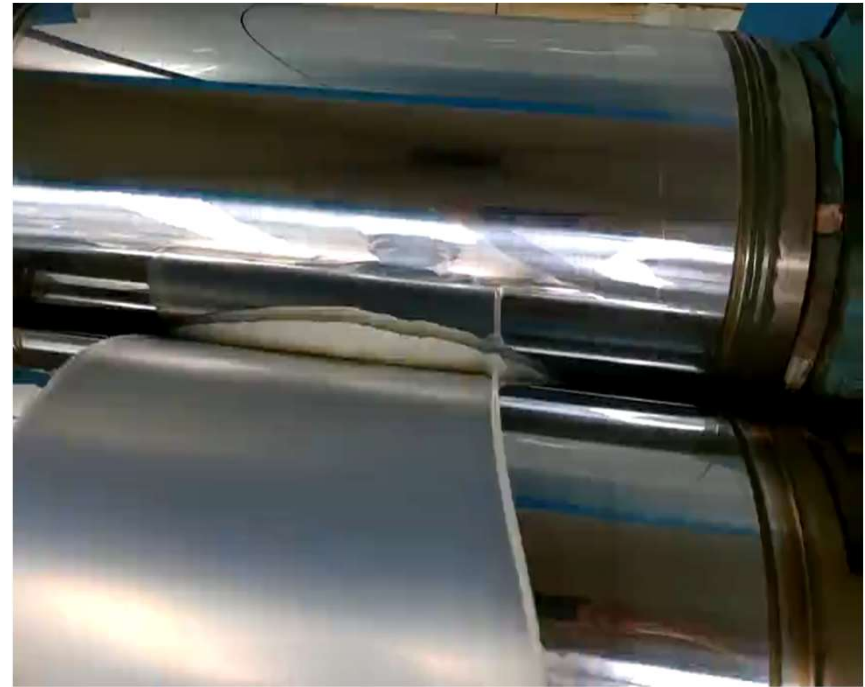


Figure 2: complete gelation



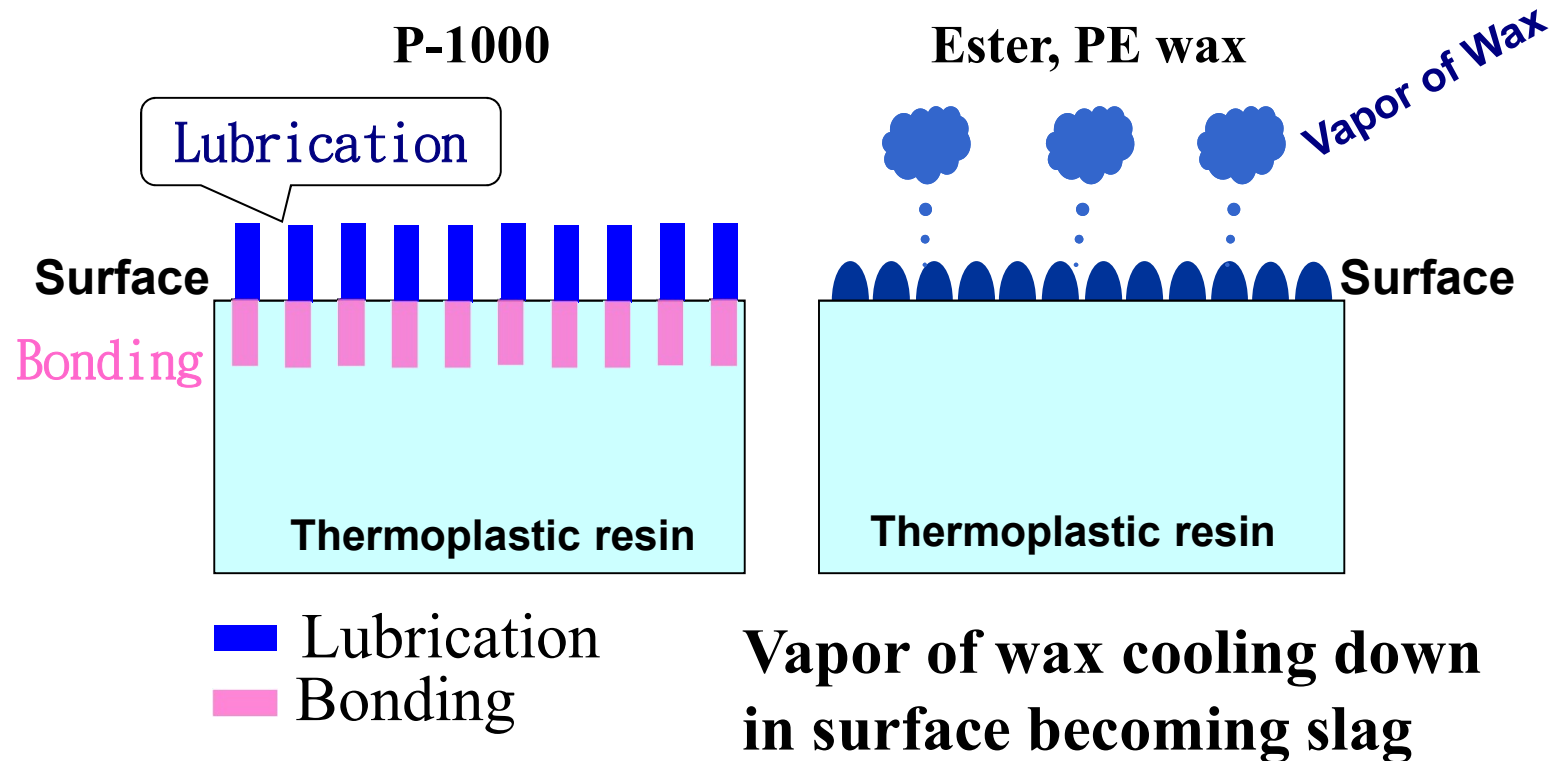
P-1000 Improved die slagging



- P-1000 Forms a film with the metal surface of the machine to achieve excellent Lubrication effect.
- P-1000 absorbed vapor of small molecular example Ester, PE wax, improved die slagging.

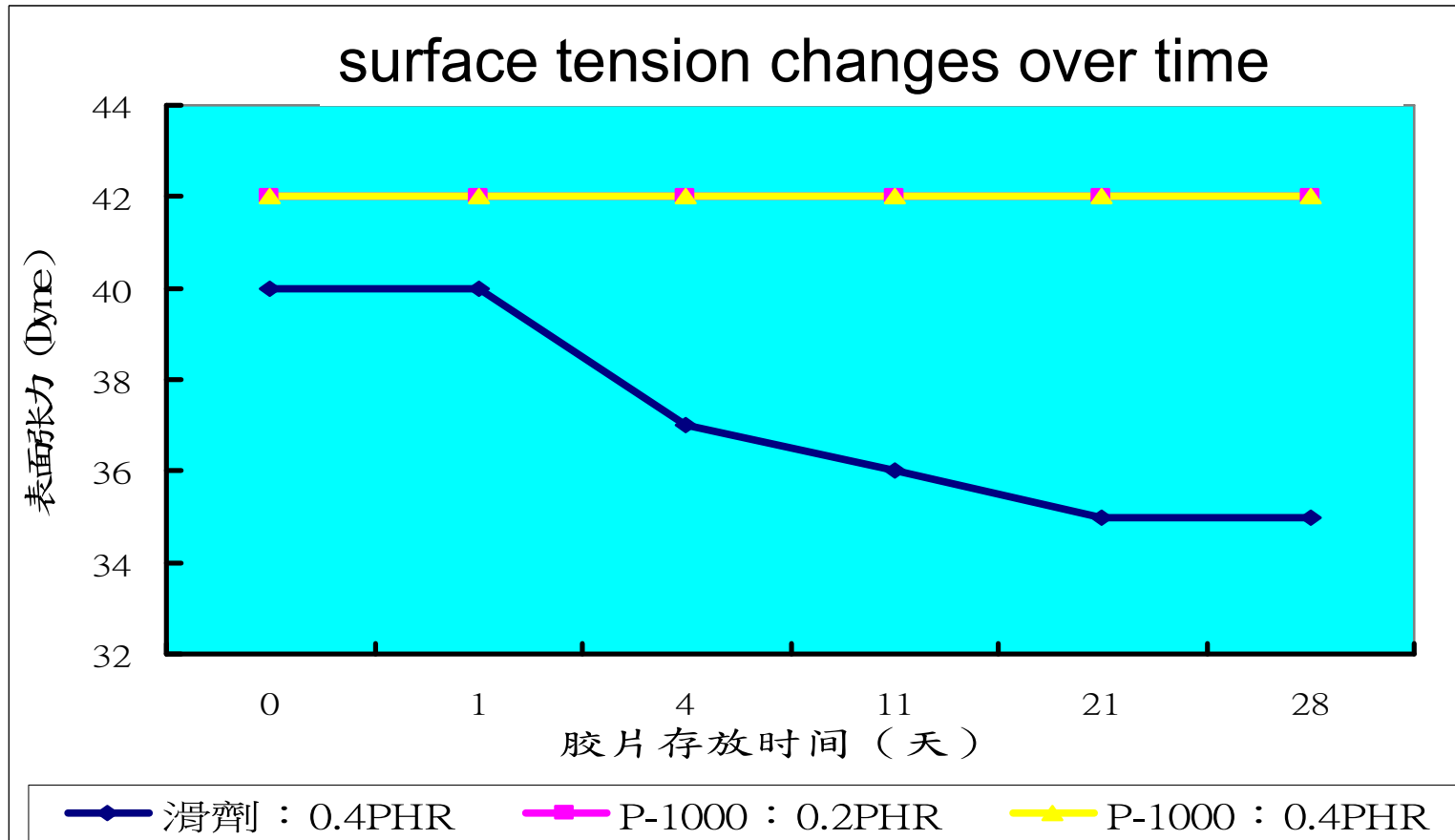
P-1000 Description :

P-1000 is a high-efficiency acrylate external Lubrication agent, providing high-performance metal stripping, long-time slippery effect during processing,

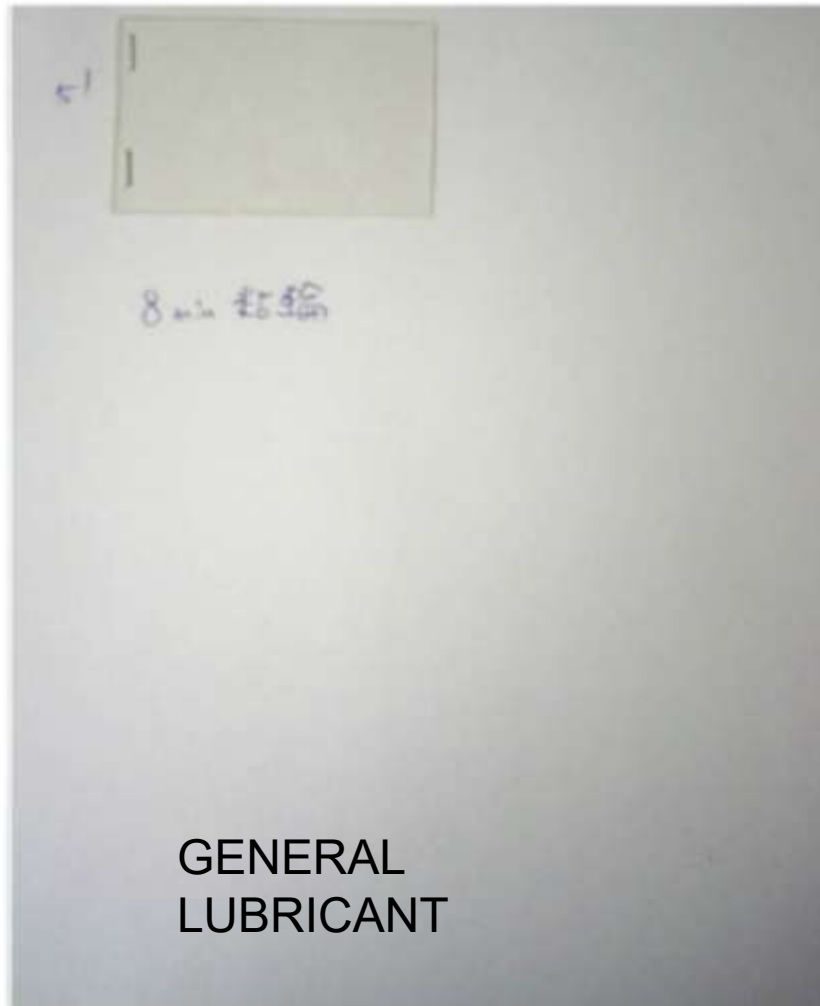


Comparison of surface tension:

- First day the surface tension of P-1000 was 2Dyne higher than that of the lubricant;
- after time-month, the difficult of surface tension using the general lubricant was large, and the change with P-1000 was not significant. and does not affect the printability.



P-1000 Improved sticky wheel



After 8min sticky wheel



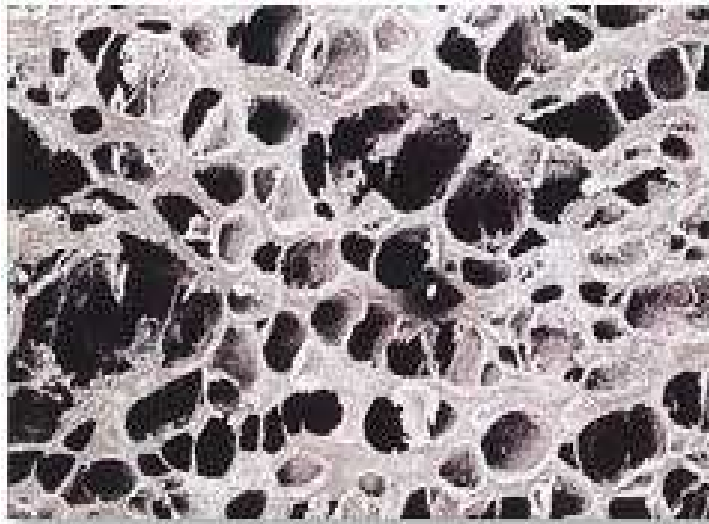
After 50min not sticky wheel



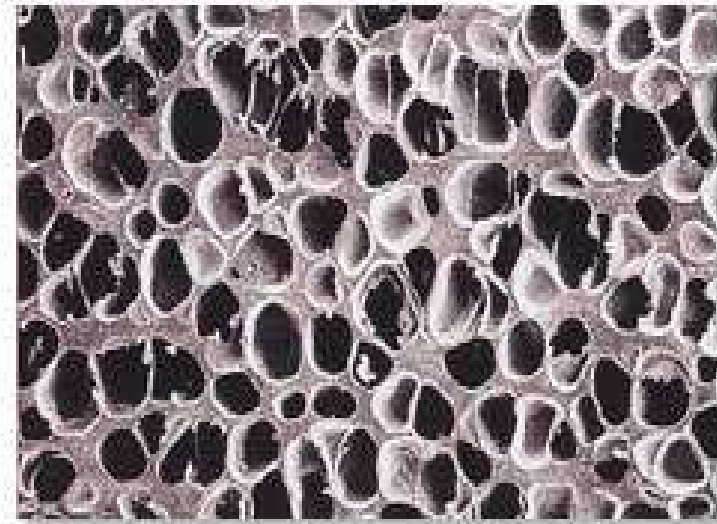
P-301 、 P-302 Character

Foam forming :

1. Improve the surface quality of product
2. Reduce the cracking of closed foam
3. make the foaming cell uniform
4. Add PA WITH high melting strength and complete cell



No Processing Aid



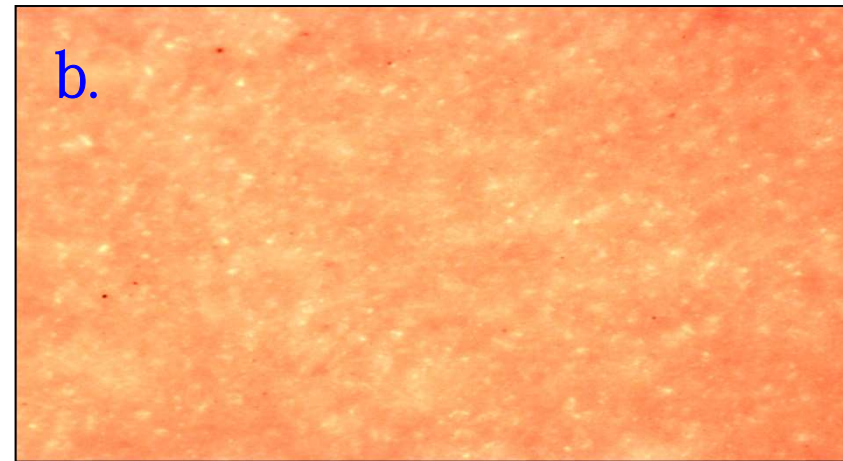
6 phr P-301



P-302 Ultra efficiency dispersion



a. Highly filled materials, poor dispersion of product ◦



b. Add P-302 to help refinement the surface ◦



Use different types of PA to solve Various problems in processing

- **EXTERNAL SLIP:** Improved printability, die slugging, anti-adhesive roller → P-101 、 P-1000
- **PROMOTE GELATION:** improve melt fluidity, smooth the surface of the product, and improve the gloss of the product. → P-201 、 P-251
- **Improve Plate Out** → P-220
- **HIGH MW:** foaming product improve surface quality and reduce cell breakage → P-301 、 P-302
- **Increase melt strength and reduce spot formation** → P-301
- **For high filler dispersion** → P-302



Report finished
THANKS FOR
LISTENING
Please guide

Expand N2.1 plant (airtight doors and windows)

- **Issue:** The volume shrinkage rate of the bar is improved, with a target of 0.01% .
- **window strips baked at 80 ° C for 1 hour is as follows::**

Item	Original formula	Improve 1	improve 2
shrinkage rate	0.16%	0.03%	0.01% ↓

- **Improve1 :** adding CPVC as modifier

S60/CPVC=90/10% , Increase the heat distortion temperature, Improve volume shrinkage.

On-line production revealed surface roughness of the product, confirming the problem of excessive gelation of stabilizers and slip agents.

- **Improve2 :**Stabilizer needs to be increased by 30%, and it is recommended to replace the external slip with P1000



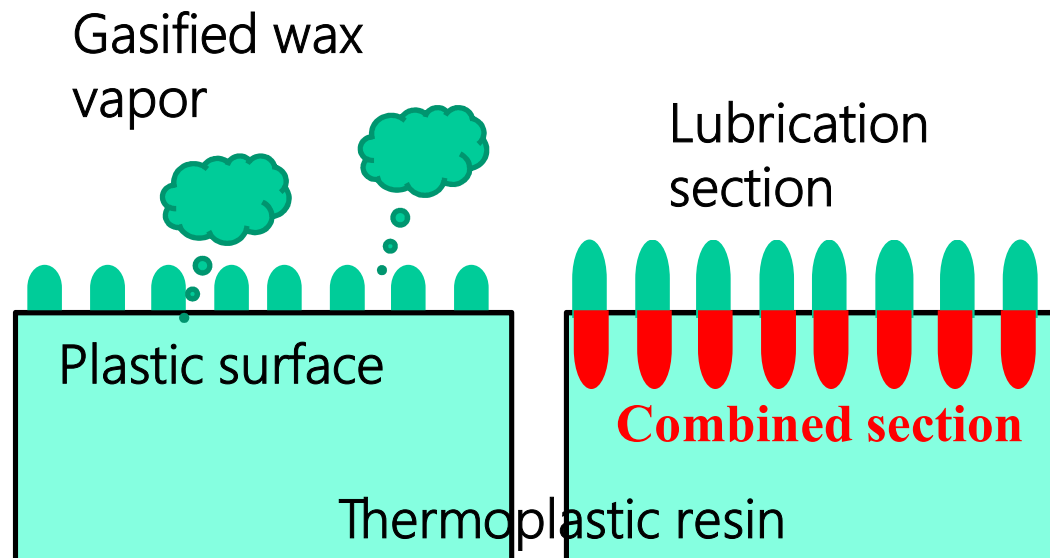
sticks as shown above



Product : Floor-standing window series Airtight folding door

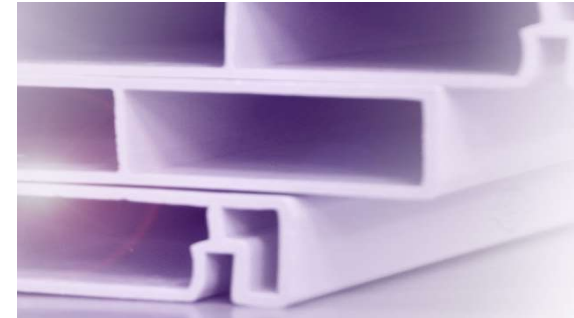
Expand N3.4 plant (Q-BOX)

- Issue : Product is Plate out in the die.
- Plate out is caused by the increase of the slip agent, and the scale is hardened and the product is scratched.
- It is recommended to replace the external slip with P1000



Small molecule slipper has Plate out.

Improve principle



Q-BOX shown above



Product : PVC
Plastic steel Q-BOX

Expand D , C company (wire and cable)

- **Topic: Chunghwa Telecom's signal line die slag. 。**
- **The customer's current situation uses a fluorine-based lubricant, and the die slag causes scratches on the surface of the wire product**
- It is recommended to maintain the cleanliness of the die with P1000



white wire(No add PA)
die slag



black (add P-1000)
NO die slag

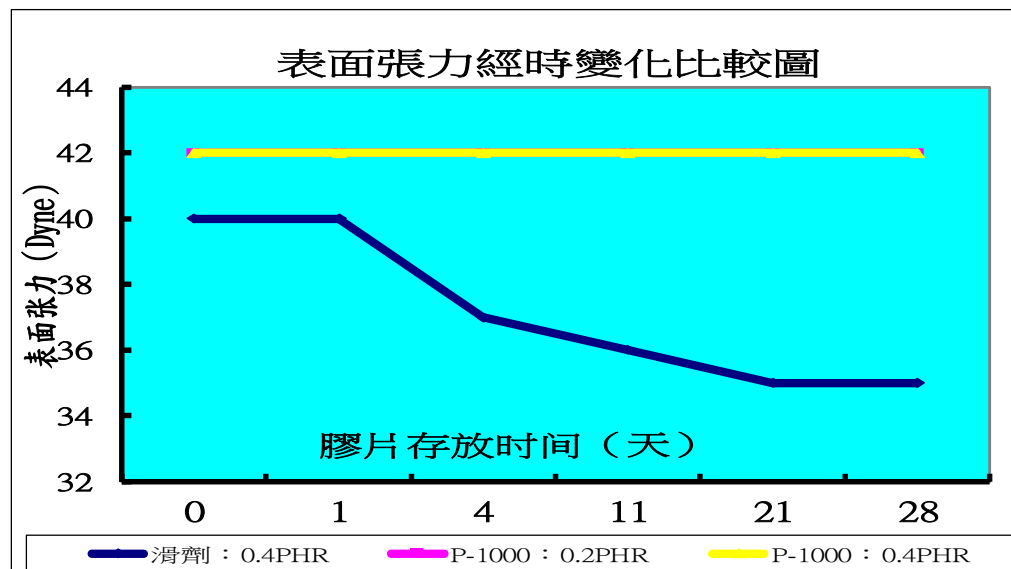


pink (add P-1000)
NO die

- **slag** The customer produced in the original 2 hours die slag, and keep clean 8 hours after the introduction of P1000. Sharing the same experience to company C (making H company compound) 。

Expand G company (Traffic cone)

- Topic: After the traffic cone is made, the reflective sheet is not firmly attached.
- The traffic cone body due to the use of environmentally friendly plasticizer (DOTP + DINCH) surface spit and plate out is serious.
- Recommended to improve the printability with P1000 (the surface tension does not decrease over 28 days).

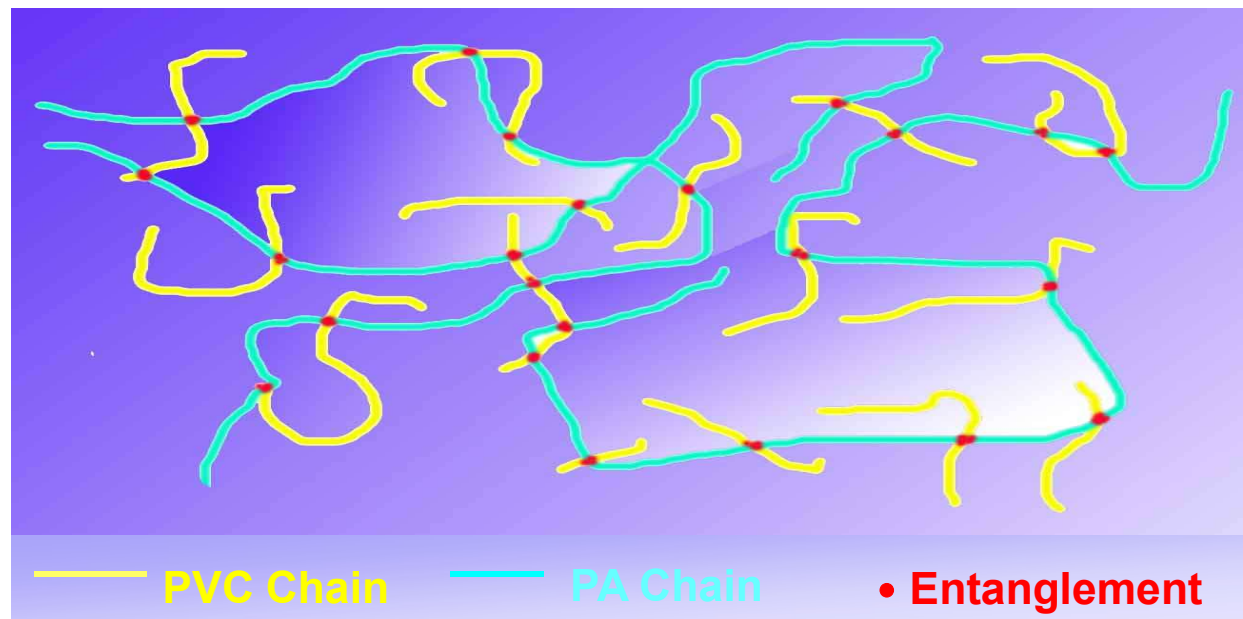


Traffic cone

- Recommended G company use Formosa Plastics S-70/S-80 powder quality is more stable.

Expand S company(Semi-rigid tape)

- Topic: Floor tile fabric mechanical strength improvement
- Company S shipped the PVC powder from Formosa. and used LG PA912 (molecular weight 1.2 million) as a gelation agent. The mechanical strength requirement was mentioned
- Recommended to use P301 (molecular weight 3 million) to improve mechanical strength, by interlinking with PVC. Product its own characteristics can also promote product gelation (both in two Function)



Expand N2.1 plant (airtight doors and windows)

- Topic: The filler is not well dispersed, and the product has insufficient local strength. ◦
- The filler can be evenly distributed in the plastic material, Comprehensive mechanical properties such as toughness and fatigue resistance are improved . the microscope to observe the poor dispersion of the filler will produce obvious highlights ◦
- Recommended to use P301 to form a network structure by strength of the product interlinking to disperse the filler. And can improve the mechanical ◦



Highly filled materials,
poor dispersion of product ◦



Product : Floor-standing
window series

K-210 Hydrolysis assessment

MI Test : 300°C / 1.2KG / Preheat 6 min

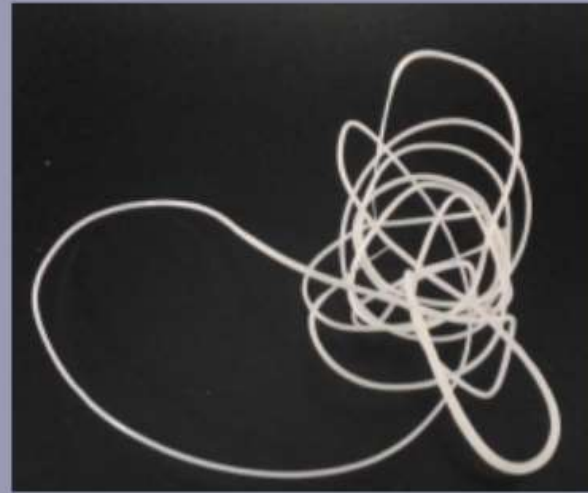
S-2001 : 31.14 (g/10 min)

K-210 : 17.80 (g/10 min)

(IR-2200+5%TPP+3%IM)



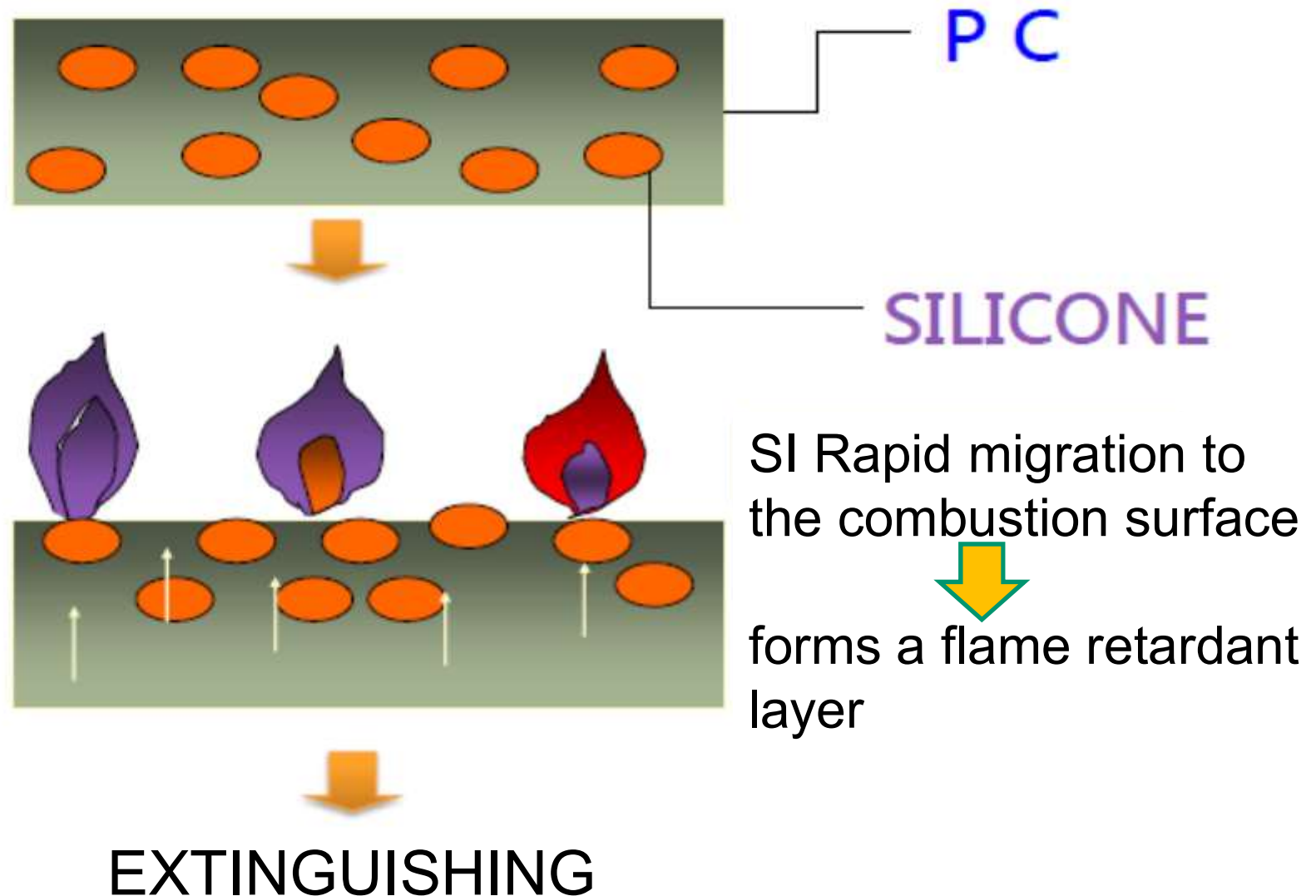
M Company(Preheat 21 min)



K-210(Preheat 21 min)

MI test results can observe the hydrolysis resistance
K-210 is better

K-210 Synergistic flame retardant



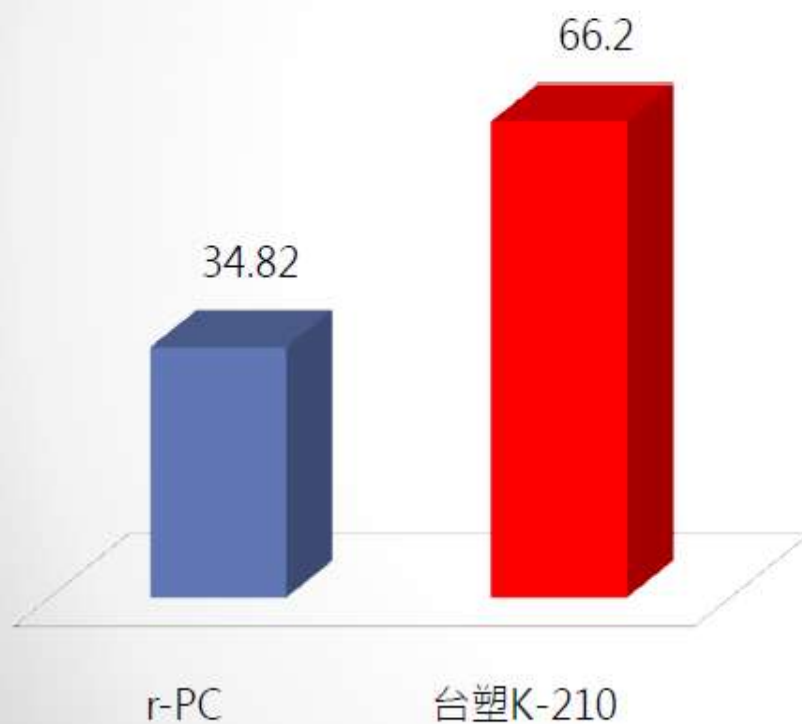


Impact Strength Index(IZOD)

ASTM D256-10
(IN r-PC resin)

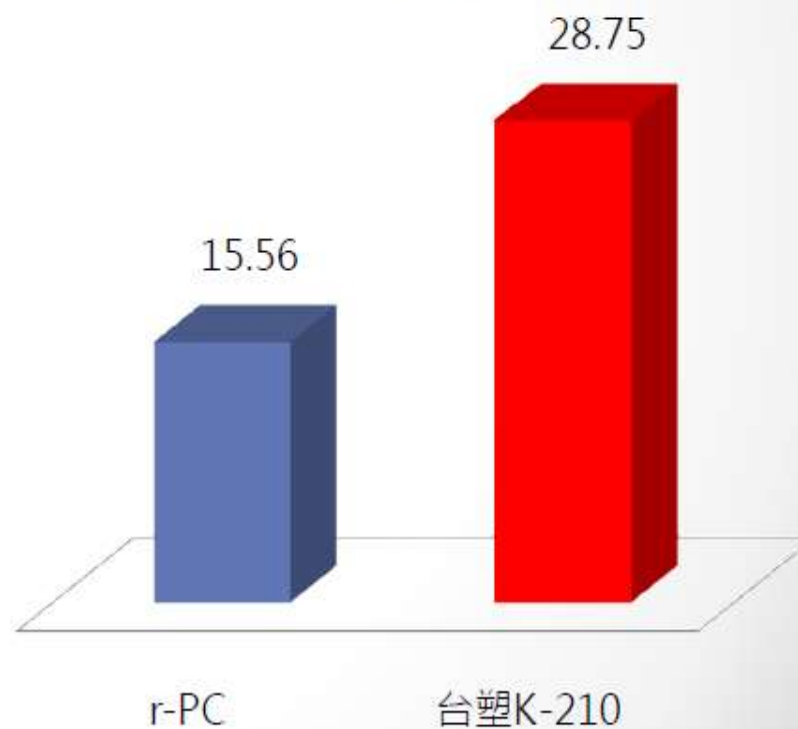
r-PC Alloy(@23°C)

Dosage 4%



r-PC Alloy(@-15°C)

Dosage 4%



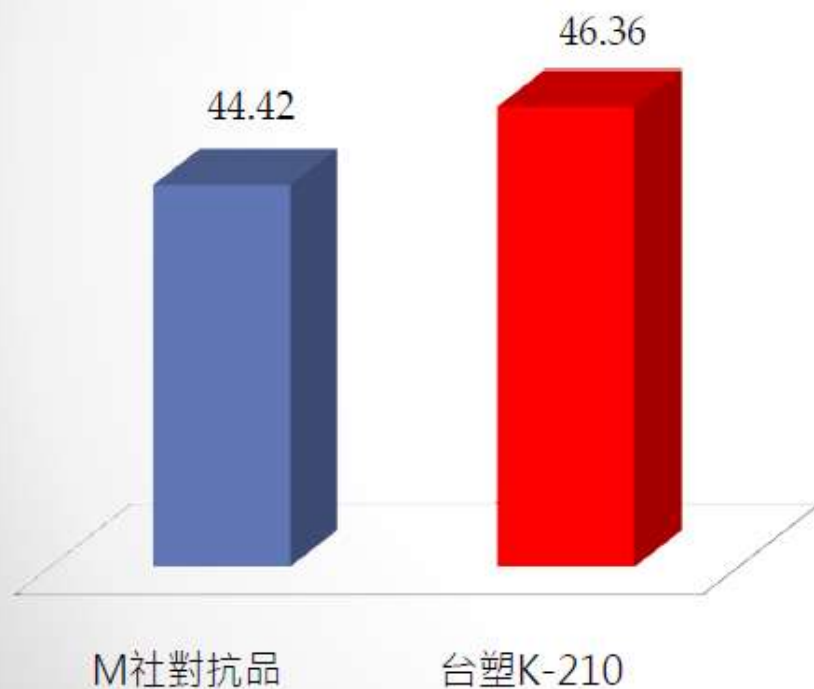


Impact Strength Index (IZOD)

ASTM D256-10
(IN PC/ABS resin)

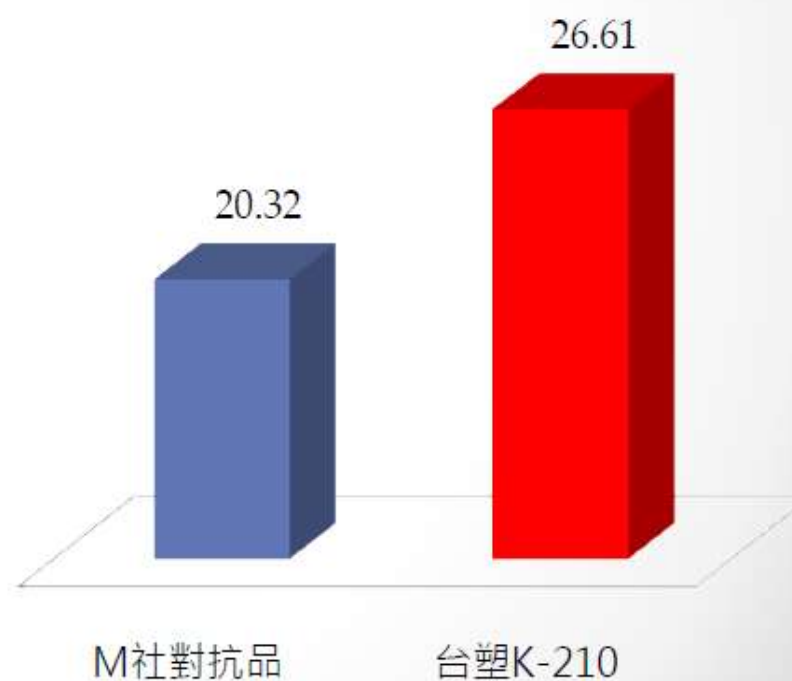
PC/ABS Alloy (@23°C)

Dosage 4%



PC/ABS Alloy (@-15°C)

Dosage 4%





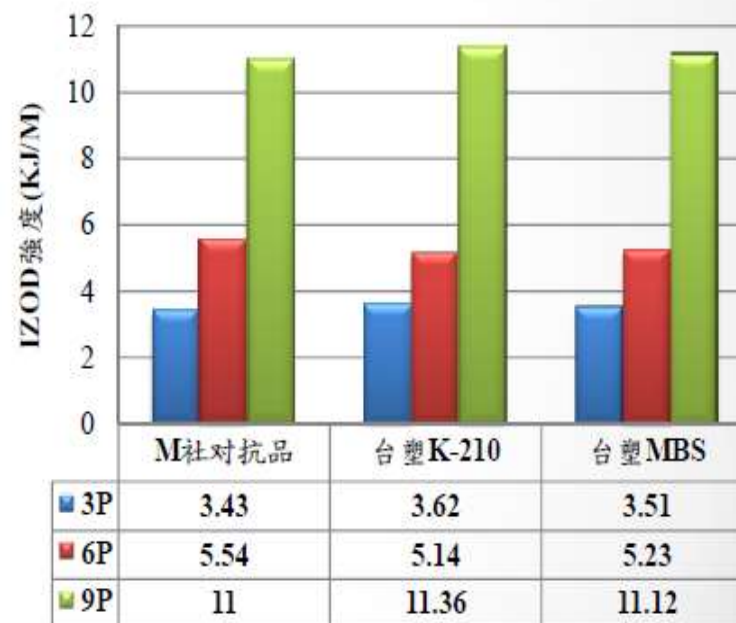
Impact Strength Index(IZOD)

ASTM D256-10
(IN PVC resin)

常温IZOD (23°C)



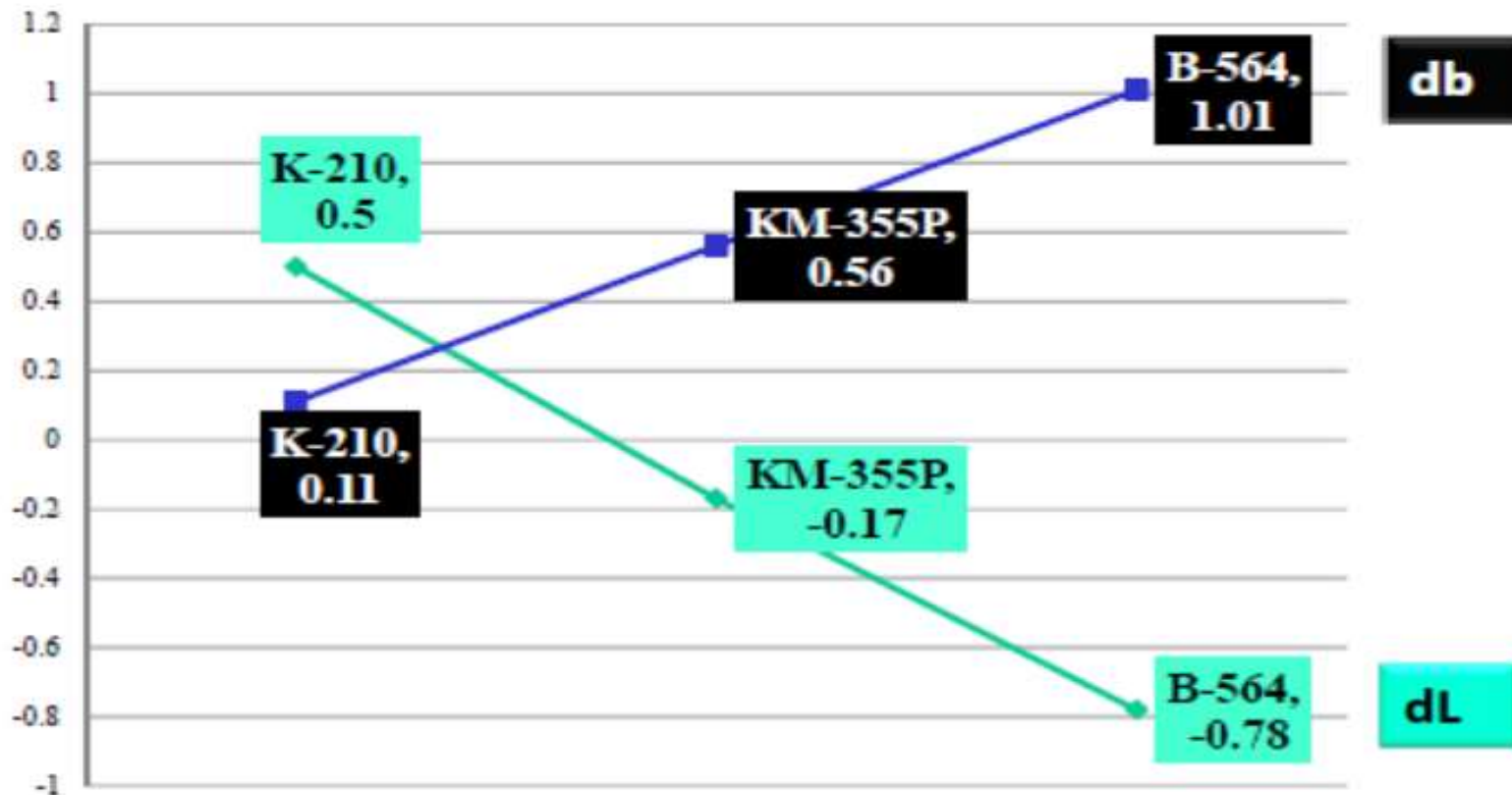
低温IZOD (-15°C@3min)





K-210 Weather resistance Test

**Silicone IM(K-210) > Acrylic IM(KM-355P) >
> MBS(B-564)**



K-210 Weather resistance Test

Machine: CI4000



Original test1 Original test1 K210 K210

**PVC+ 4PHR K210 Irradiation 3,500HR Xenon lamp ,
Weather resistance is best(PIPE&PROFILE)**

剛性試験 Flexural modulus

