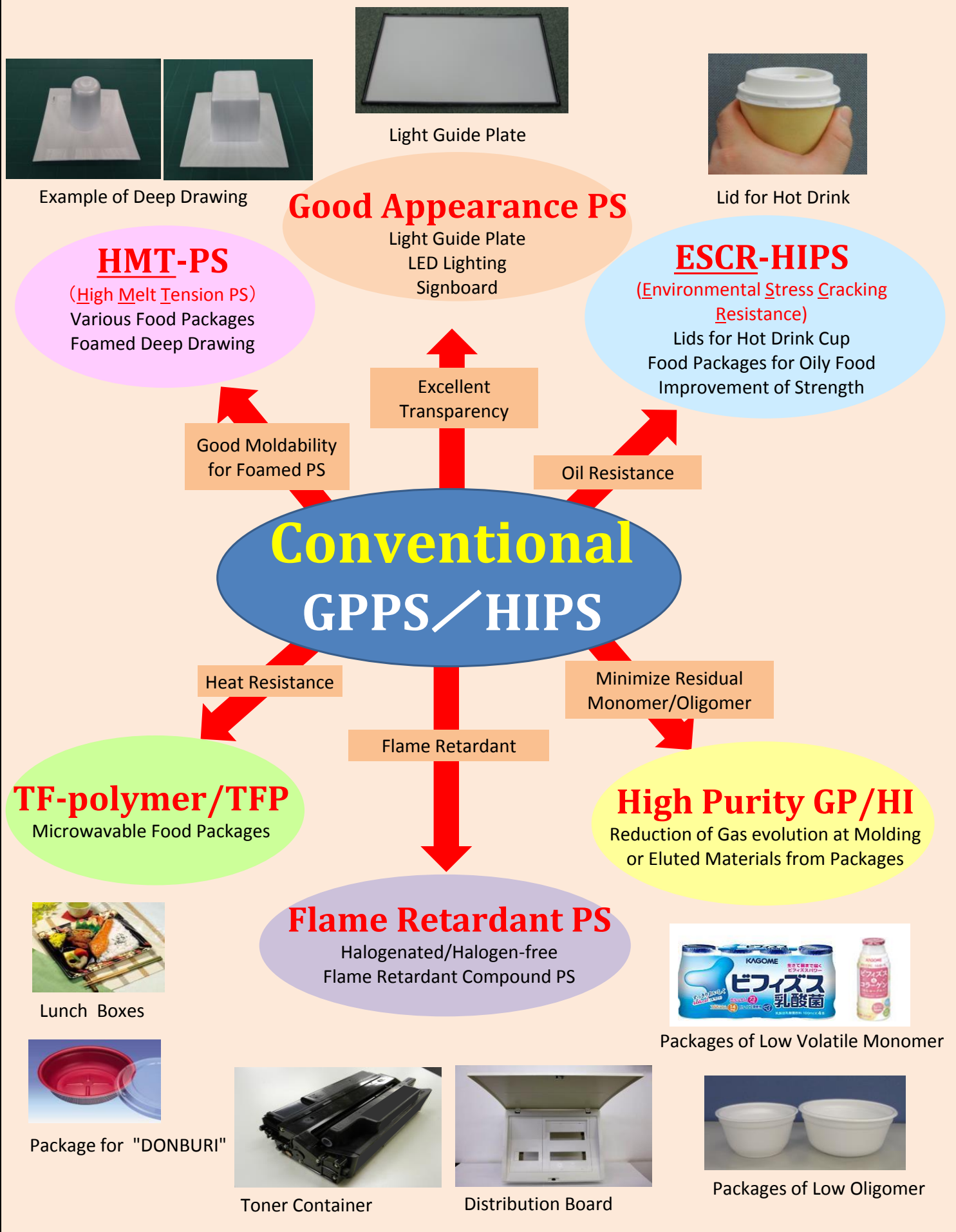


Next Stage of Polystyrene

TOYO STYRENE Co.,Ltd.

<Lineup of Toyo Styrene's High Functional Polystyrene>



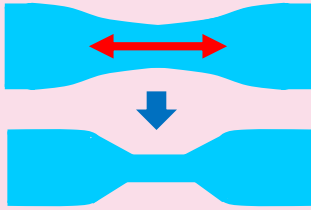
High Melt Tension Polystyrene(HMT-PS)

HMT-PS has very high Melt Tension by our own polymerization technology.

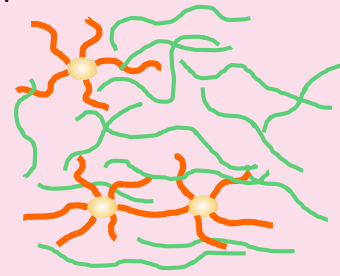
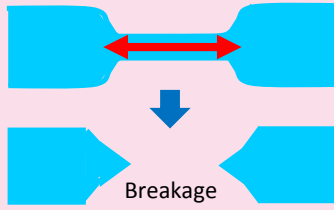
It is good material for SHEET/FILM productin.

Forming productions of HMT-PS have good FORMABILITY, THICKNESS UNIFORMITY.

High strain-Hardening (HMT-PS)



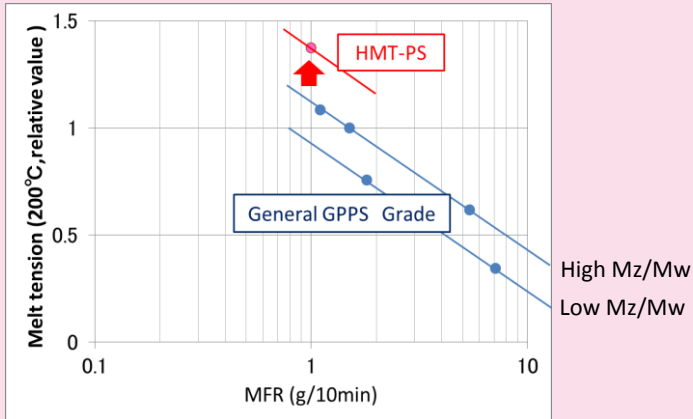
Low strain-Hardening (General PS)



HMT-PS polymer structure image

HMT-PS physcal property

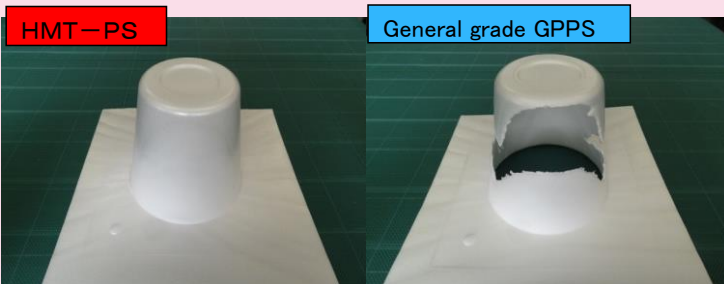
	unit	HMT-PS
Melt mass flow rate	g/10min	1.0
Vicat softening temp.	°C	103
Charpy impact strength	kJ/m2	2.1
Tensile breaking stress	MPa	45
Tensile breaking strain	%	3
Flex strength	MPa	100
Flexural modulus	MPa	3,200



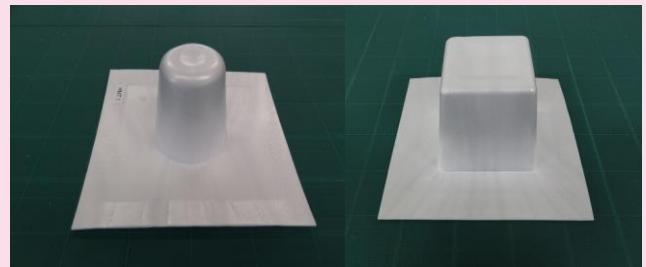
[Application]

- Polystyrene Paper (PSP, Formed expansion sheet for food container)
- Expanded Polystyrene board (XPS, Foamed heat insulation material)
- Biaxial oriented Polystyrene(BOPS)
- Injection blow formed productions
- Inflation films
- HIPS sheet formed package

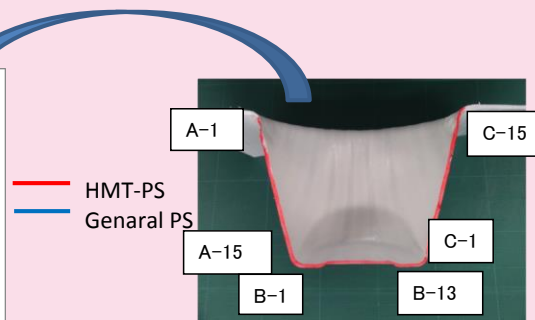
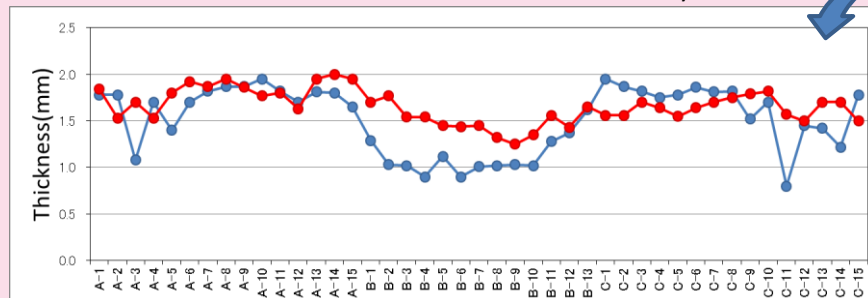
[PSP forming test]



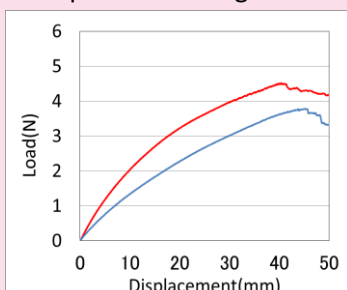
Forming samples with HMT-PS (PSP containers)



Food container thickness uniformity



Compression strength of food container



— HMT-PS
— General PS

Measuring method



TOYO STYRENE High Functional GPPS and HIPS

1. ESCR-HIPS / Impact Modifier for HIPS

Improved Oil Resistance of HIPS by Polymerization Technologies

Application : Lids for Hot Drink Cup, Food Packages for Oily Food, Inner Panels of Refrigerator and so on
Use as Impact Modifier Less Expensive, Substitute for SBR (Enable to Reduce Cost 5-15%)



Lid for Hot Drink Cup



Inner Panels of Refrigerator

Resistance Test for HIPS and Various Oil

	Conventional HI		ESCR-PS	
Aging time	1hour	24hours	1hour	24hours
Rapeseed oil	Poor	Poor	Good	Good
Sesame oil	Good	Poor	Good	Good
Olive oil	Poor	Poor	Good	Good
Rice oil	Good	Poor	Good	Good
Butter	Good	Poor	Good	Good
Lard	Good	Poor	Good	Good
Fresh cream	Poor	Poor	Good	Good

Test Method



Physical Properties

Properties	Test method	unit	
Melt mass flow rate	ISO 1133	g/10min	3.3
Vicat softening temp.	ISO 306	°C	88
Charpy impact strength	ISO 179	kJ/m ²	19
Tensile breaking stress	ISO527-1,527-2	MPa	22
Tensile breaking strain	ISO527-1,527-2	%	70
Flexural strength	ISO 178	MPa	38
Flexural modulus	ISO 178	MPa	1750

Resistance Test for HIPS and Various Kitchen Items

	Conventional HI		ESCR-PS	
	Critical Strain (%)	Judge	Critical Strain (%)	Judge
Soy Sauce	0.2	Poor	>1.1	Good
Ketchup	0.2	Poor	>1.1	Good
Vinegar	0.3	Poor	>1.1	Good
Detergent (neutral)	0.2	Poor	0.5	Fair
Detergent (alkaline)	0.5	Fair	>1.1	Good

Critical Strain: Calculated by Defined Formula and Cracked Point
(Toyo Styrene Method)

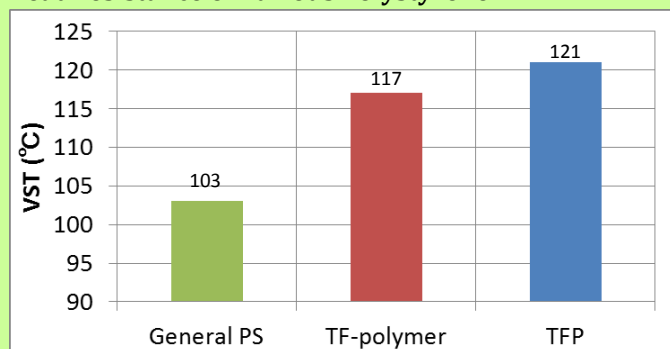


2. Improvement of Heat Resistance

Improved Heat Resistance of Polystyrene, then named "TF-polymer" and "TFP" with Higher Strength

Application : Microwavable and the other Food Packages , Foamed PS Tray and so on

Heat Resistance of Various Polystyrene



Package for "DONBURI"



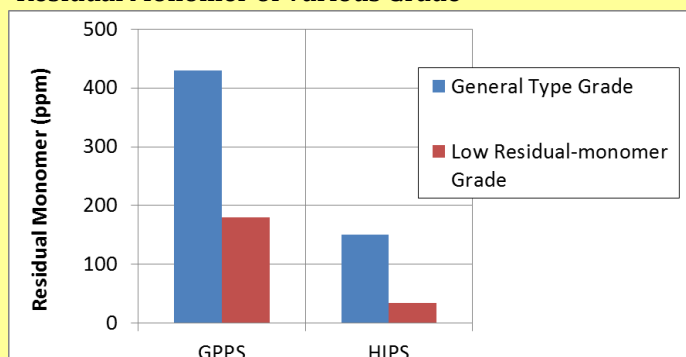
Lunch Boxes

3. Reduction of Residual Monomer & Residual Oligomer

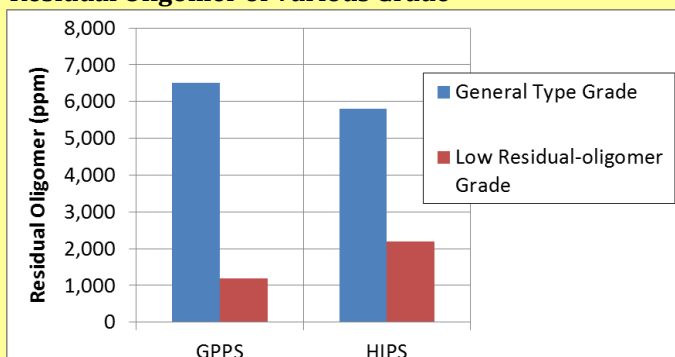
Reduced Residual Monomer and Oligomer by Special Equipment and Polymerization Technologies

Application : Food Packages

Residual Monomer of Various Grade



Residual Oligomer of Various Grade



TOYO STYRENE Good Appearance Polystyrene

1. Extremely Transparent Grade

Characteristic Properties of Polystyrene

- Low Specific Gravity
- Transparency
- Low Water Absorption
- Good Moldability
- Low Price

Plastics	PS	PMMA	PC
Specific Gravity	1.05	1.19	1.19
Transparency	Good	Excellent	Good
Water Absorption Resistance	Excellent	Poor	Fair
Moldability	Good	Fair	Fair

Polystyrene with **Long Light Path Transparency**

Application: Light Guide Plate, other Long Light Path Items



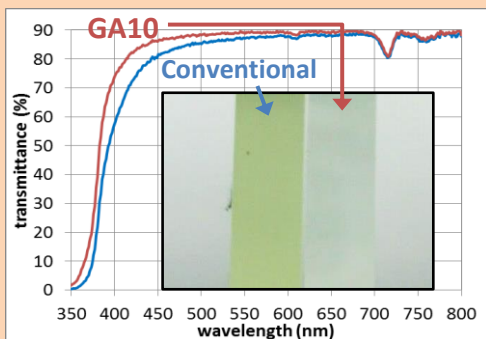
Light Guide Plate

Optical Properties of Various Plastics

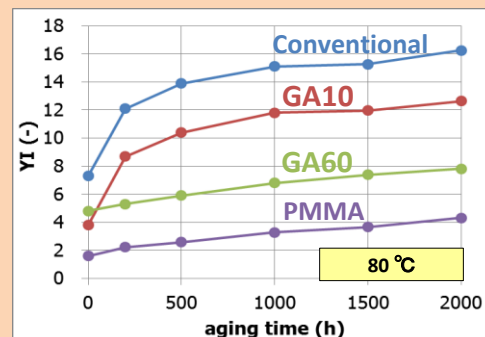
Plastics			PS		MS	PMMA	PC
Grade			Conventional	GA10	Optical	Optical	Optical
2mm Path	Tt	%	90.5	90.5	91.6	92.6	90.4
	YI	-	8.0	3.8	3.8	1.6	7.6
115mm Path	Tt	%	82.8	85.9	87.4	88.4	80.6
	YI	-	8.0	3.8	3.8	1.6	7.6

*Short light-path transparency is same in all PS.
But "GA10" have higher long light-path transparency.

Tt: Total Light Transmittance
YI: Yellow Index



Spectra of PS

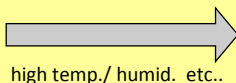


Aging Test of PS and PMMA

*We also have "GA60", less color change type in use.

2. Whitening Resistant Grade

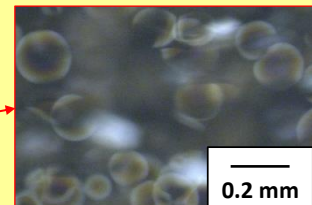
Whitening: A phenomenon PS become hazy because of the various environment.
e. g.) high temperature / humidity, hot water, freeze.



high temp./ humid. etc..



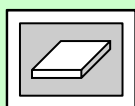
*A lot of disk-shaped voids are inside.



Polystyrene without **Whitening caused by the**

Application: Bathroom, Items Exposed to Hot/Wet condition

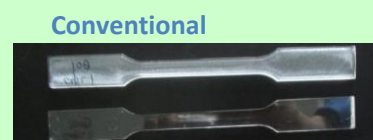
High Temp. / Humid. Exposure Test



60 °C, 90%RH × 48 h



23 °C, 50%RH × 2 h



Whitening Resistant Grade

*This grade is prevented from being hazy.