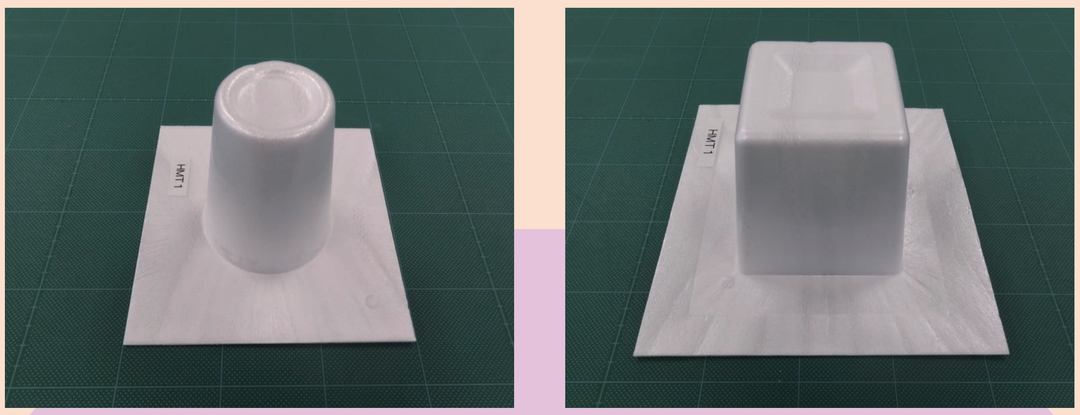
Next Stage of Polystyrene

TOYO STYRENE Co.,Ltd.

<Lineup of Toyo Styrene's High Functional Polystyrene>



Example of Deep Drawing

HMT-PS

(High Melt Tension PS)

Various Food Packages
Foamed Deep Drawing Cups



Lid for Hot Drink Cup

ESCR-HIPS

(Environmental Stress Cracking Resistance)

Lids for Hot Drink Cup
Food Packages for Oily Food
Improvement of Strength

Good Moldability for Foamed PS

Oil Resistance

Conventional

GPPS／HIPS

Heat Resistance

Minimize Residual Monomer/Oligomer

TF-polymer/TFP

Microwavable Food Packages



Lunch Boxes



Package for "DONBURI"

High Purity GP/HI

Reduction of Gas evolution at Molding
Reduction of Elute Materials from Packages



Packages of Low Oligomer



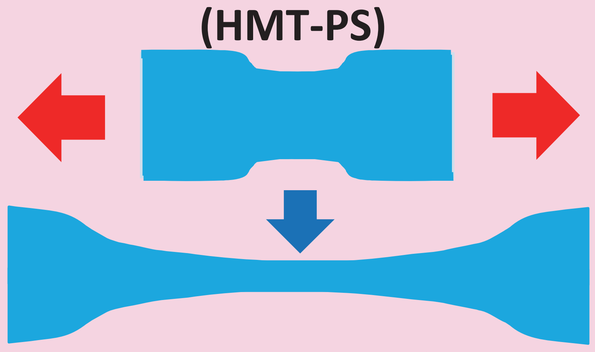
Packages of Low Volatile Monomer

TOYO STYRENE High Functional GPPS and HIPS

1. High Melt Tension Polystyrene(HMT-PS)

HMT-PS has very high Melt Tension and high Strain-Hardening property by our own polymerization technology.
It is good material for SHEET/FILM production.
Forming productions of HMT-PS have good FORMABILITY, THICKNESS UNIFORMITY.

High strain-Hardening (HMT-PS)

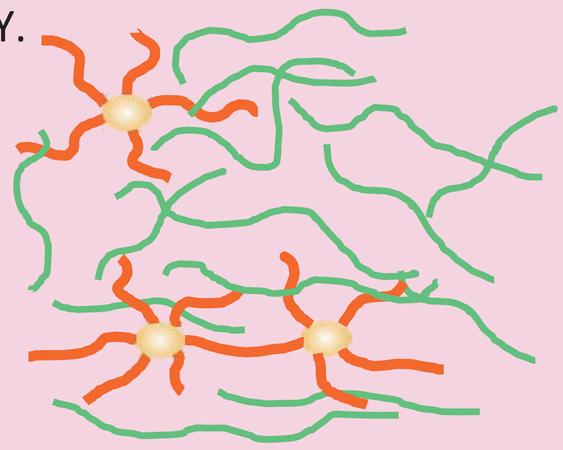


Uniform thickness layer formation

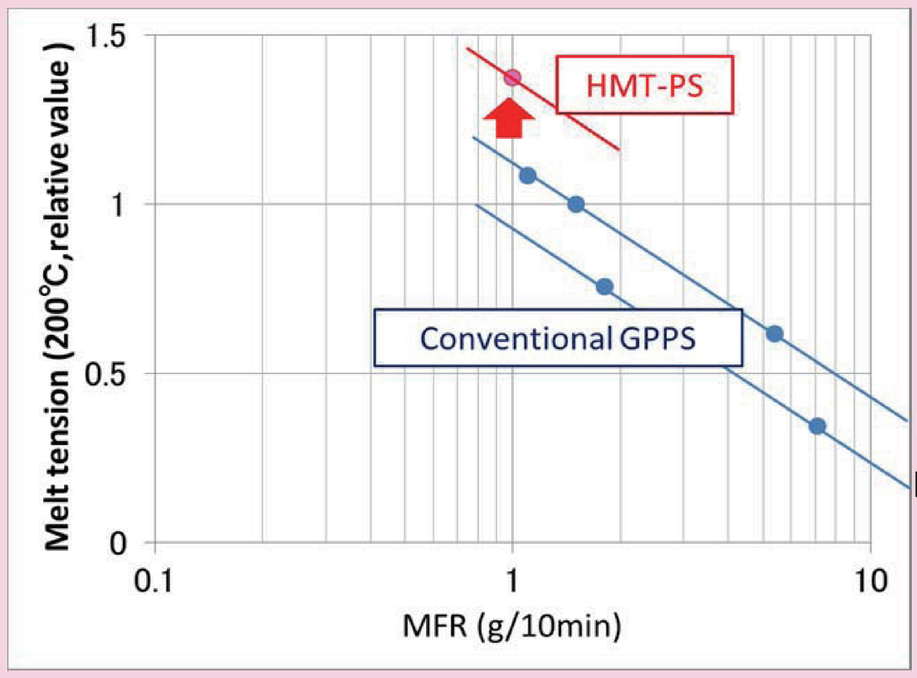
Low strain-Hardening (Conventional GPPS)



Broken or Large uneven thickness



HMT-PS polymer structure image



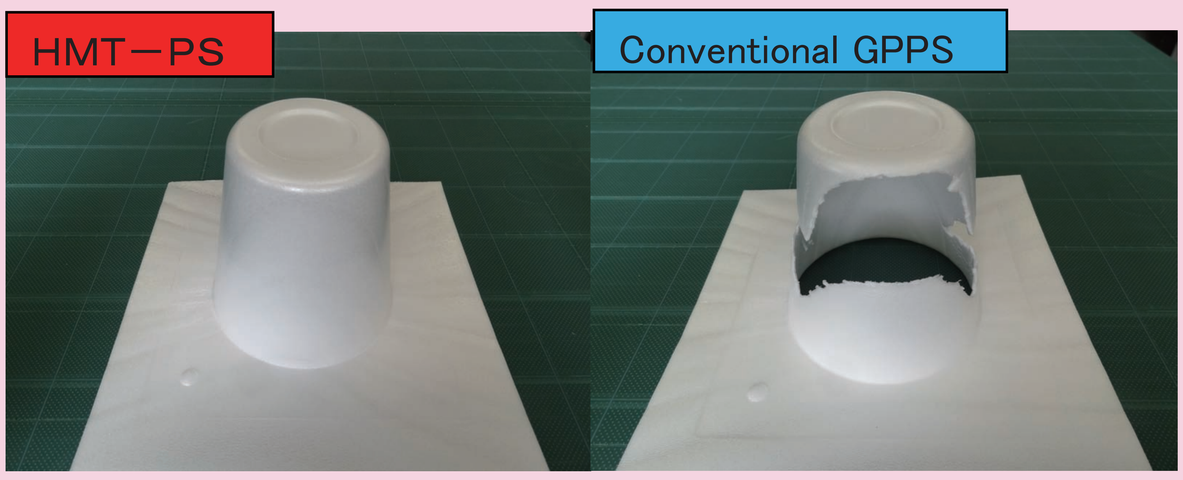
Physical properties of HMT-PS

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

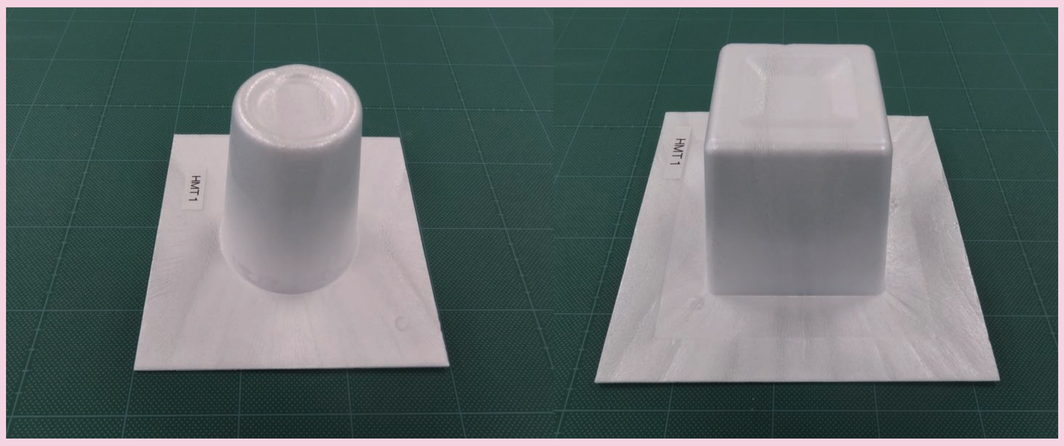
[Application]

- Polystyrene Paper (PSP, Foamed 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

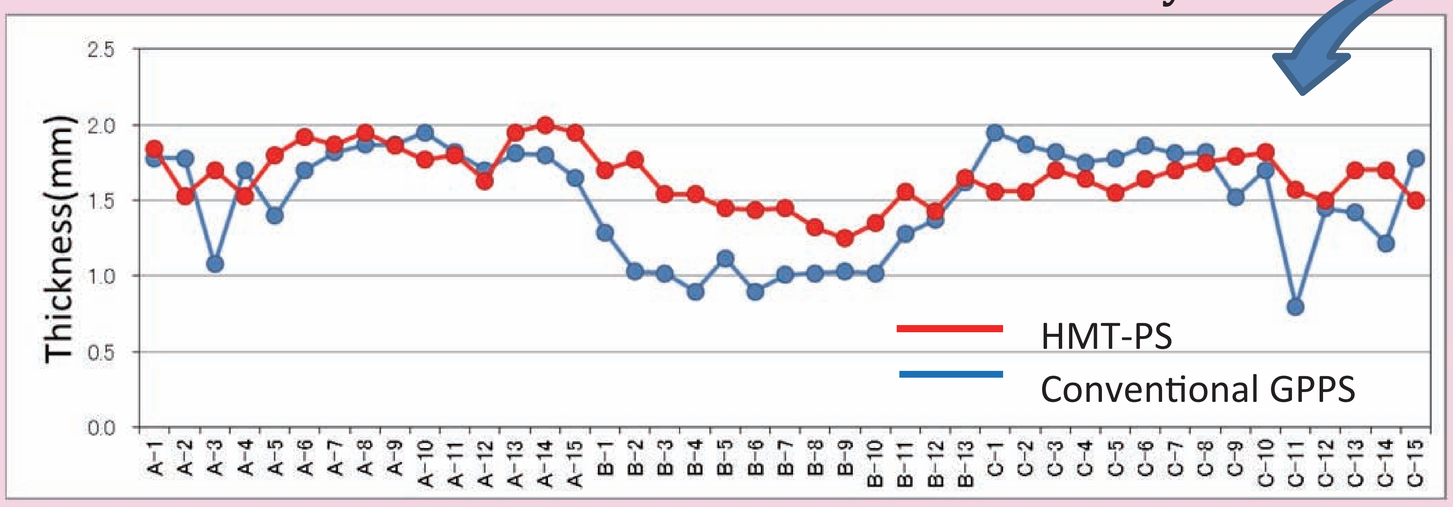
[Forming test of PSP]

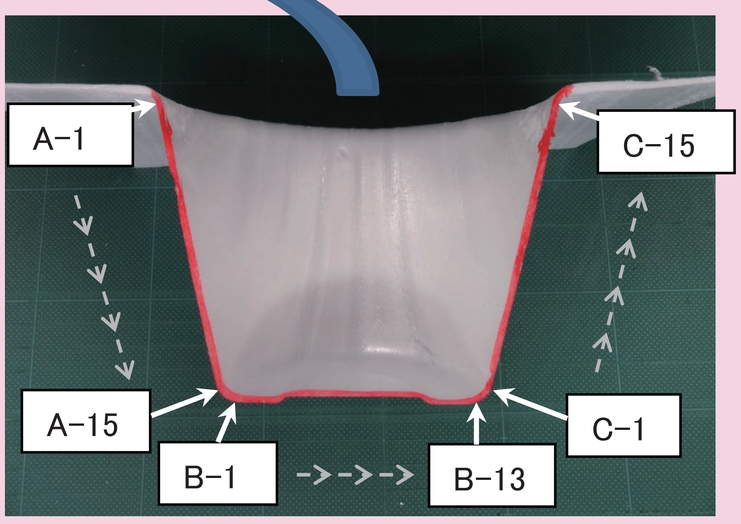


Forming samples with HMT-PS (PSP containers)

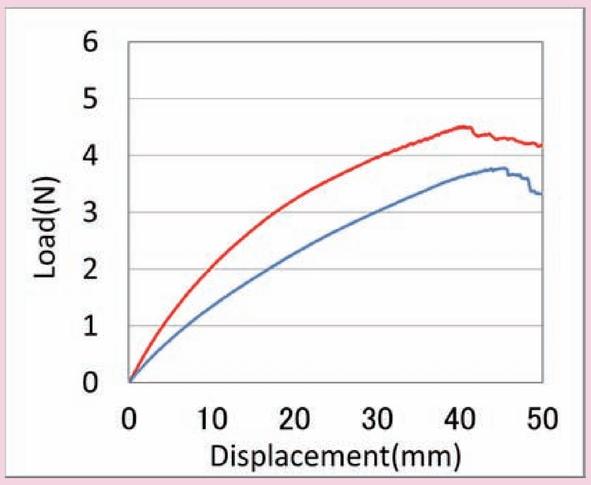


Food container thickness uniformity





Compression strength of food container



HMT-PS
Conventional GPPS

Measuring method



TOYO STYRENE High Functional GPPS and HIPS

2. 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

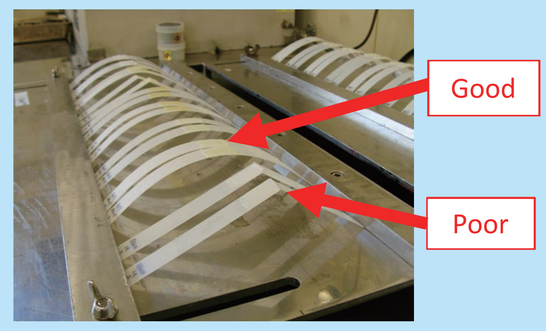


Inner Panels of Refrigerator

Resistance Test for HIPS and Various Oil

	Conventional HI		ESCR-PS	
Aging time	1hour	24hours	1hour	24hours
Rapeseed oil	Poor	Poor	Good	Good
Sesami 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	℃	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)

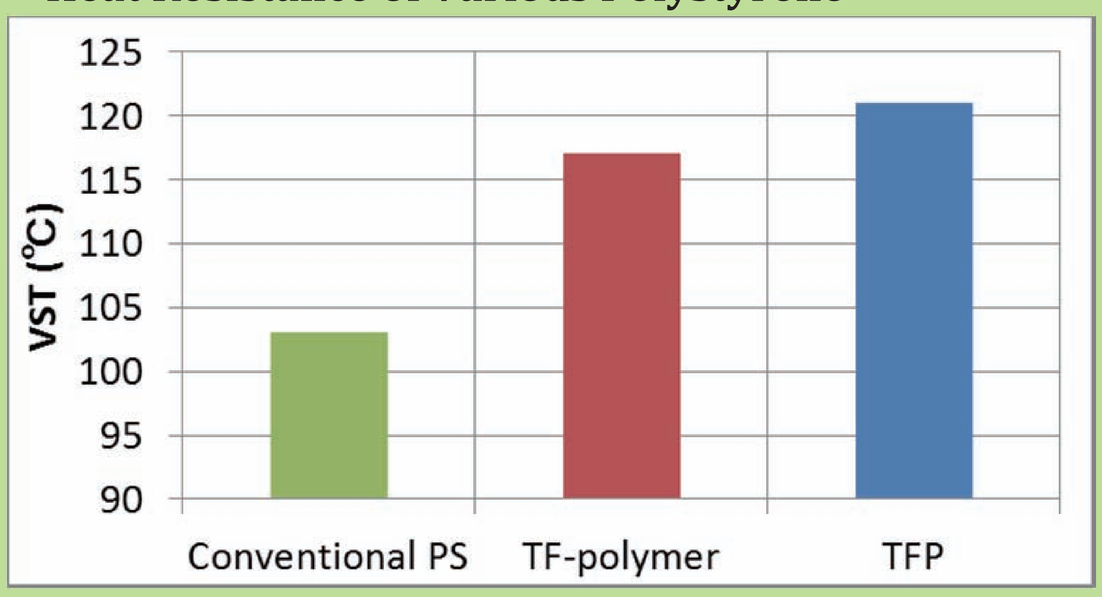


3. Improvement of Heat Resistance

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"



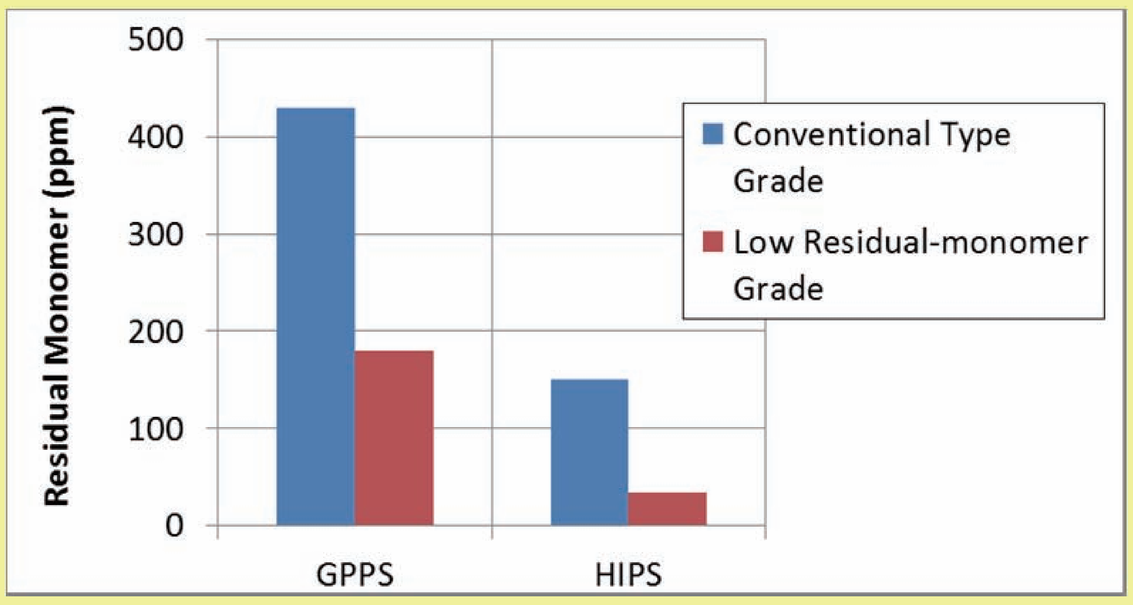
Lunch Boxes

4. Reduction of Residual Monomer & Residual Oligomer

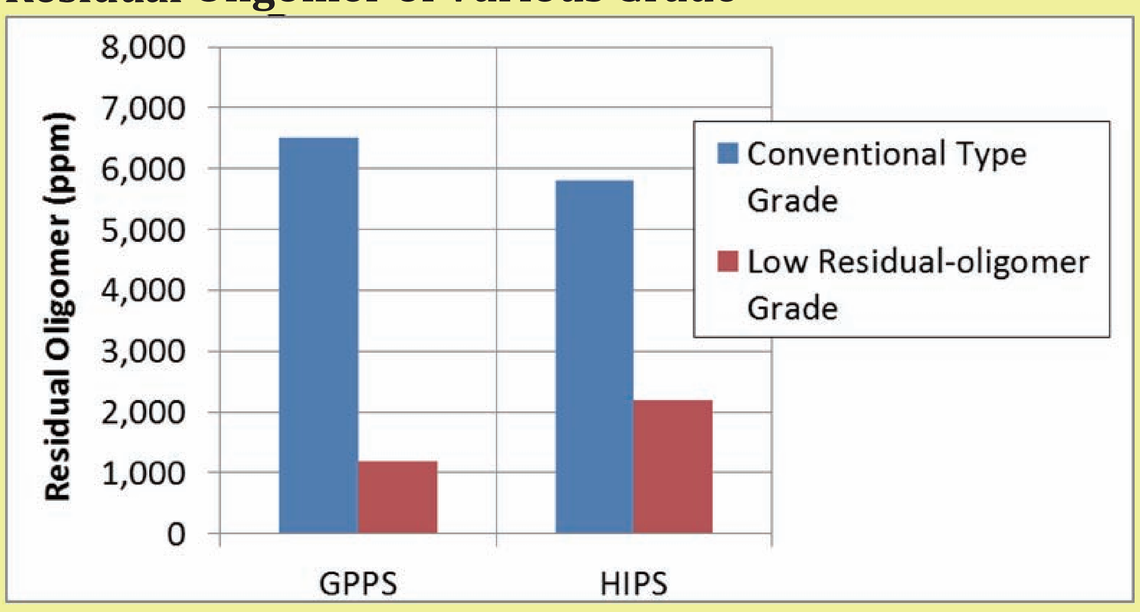
Reduced Residual Monomer and Oligomer by Special Equipment and Polymerization Technologies

Application： Food Packages

Residual Monomer of Various Grade



Residual Oligomer of Various Grade



No.1 PS Producer in Japan

at its Capacity and Technology.



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TEL : +81(3)3519-5600 FAX : +81(3)3519-5605
E-mail Address： tech@toyo-st.co.jp

Capital Stock : 5billion yen
Stock Holders : Denki Kagaku Kogyo (50%), Nippon Steel & Sumikin Chemical (35%) & Daicel (15%)
Production Capacity : Natural : 330,000t/y
Compound : 63,000t/y
Sales Volume (2014) : 49.0billion yen
Business Breakdown : Production,Sales, R & D of Polystyrene resins.
ISO Environmental system : ISO14001
Quality system : ISO9001
Occupational Safety and Health System:OHSAS18001(Some plants)

