

PP Modification using SEPTON™ and HYBRAR™

Elastomer R&D Dept.
Elastomer Division

kuraray

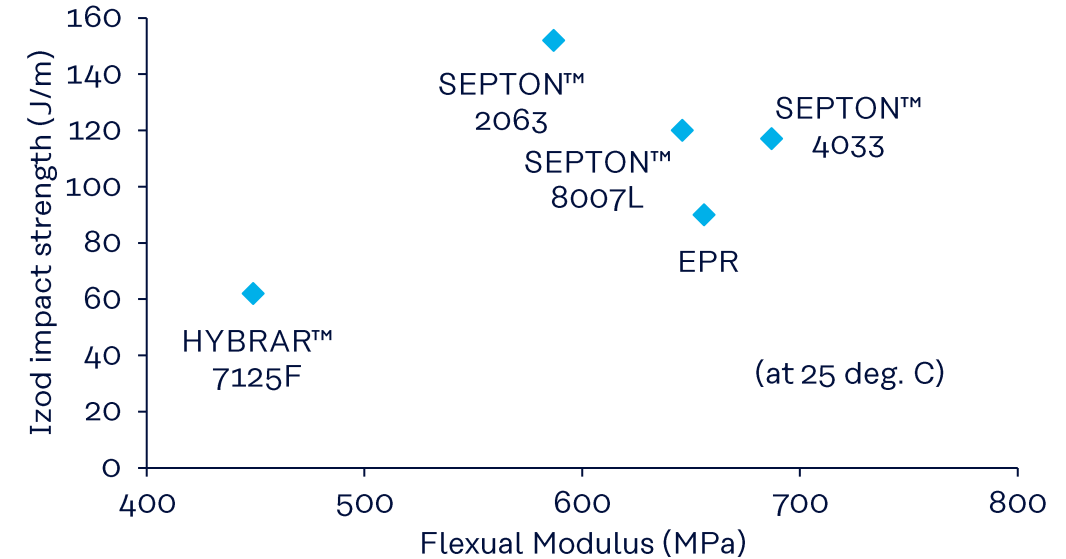
Septon™

Hybrar™

Impact Modification (1)

(Basic Formulation: Homo-PP/Elastomer (80/20 by wt))

Elastomer	Type	Styrene content (wt%)	Flexural modulus (MPa)	Izod impact strength at 25 deg. C (J/m)
Ethylene-Propylene Rubber (EPR)		0	656	90
SEPTON™ 2063	SEPS	13	587	152
SEPTON™ 8007L	SEBS	30	646	120
SEPTON™ 4033	SEEPS	30	687	117
HYBRAR™ 7125F	Vinyl-bond rich SEPS	20	449	62



SEPTON™

Good balance between impact strength and flexural modulus

HYBRAR™

Good softening effect

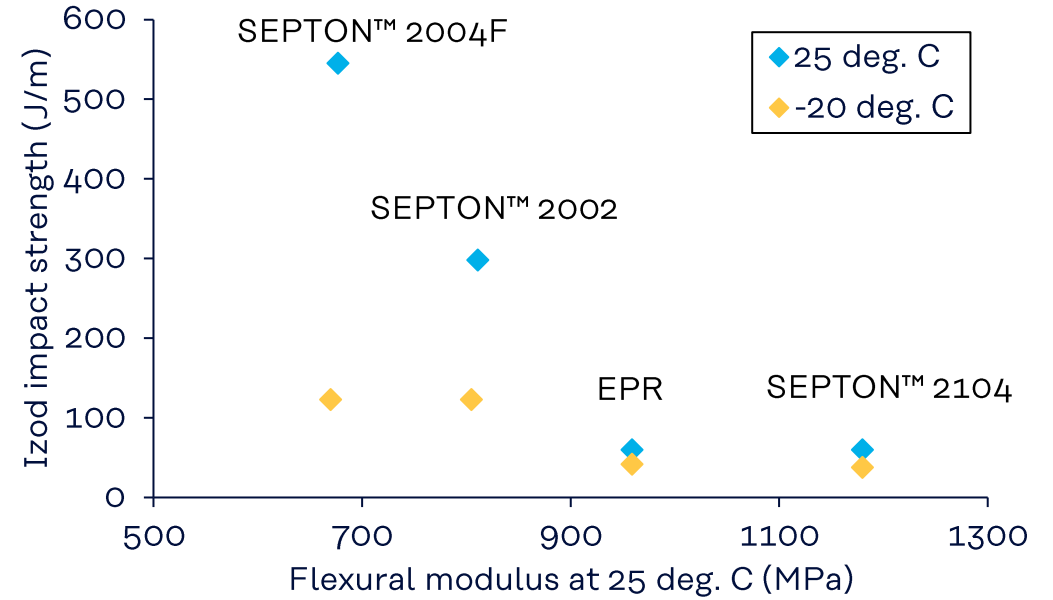
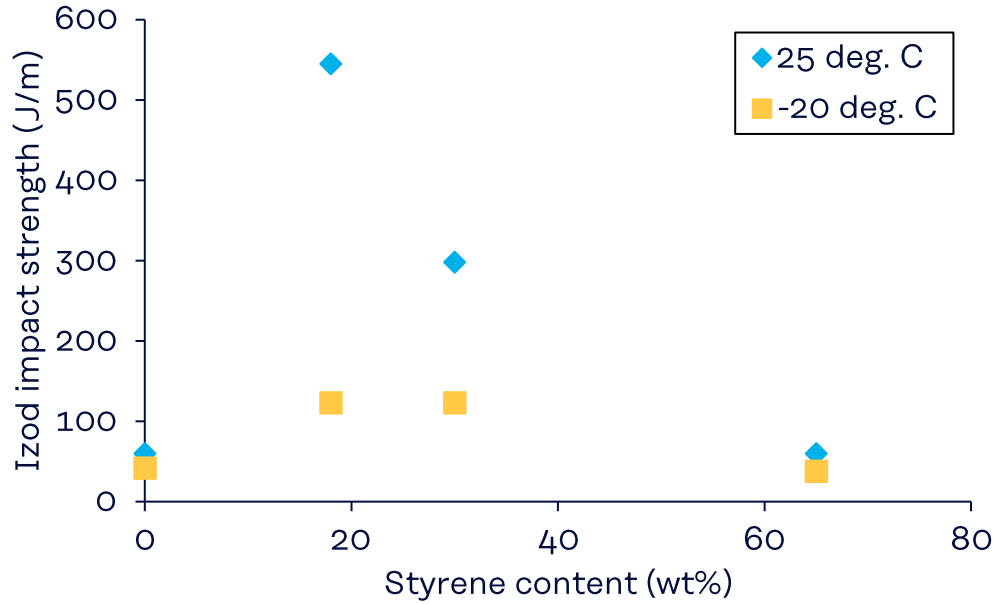
Impact Modification (2)

(Practical Formulation: Block-PP/Elastomer/Talc (73/18/9 by wt))

Elastomer	Type	Styrene content (wt%)	Flexural modulus (MPa)	Izod impact strength	
				25 deg. C (J/m)	-20 deg. C (J/m)
EPR		0	959	60	42
SEPTON™ 2004F	SEPS	18	677	545	123
SEPTON™ 2002	SEPS	30	811	298	123
SEPTON™ 2104	SEPS	65	1180	60	38

Impact Modification (2)

(Practical Formulation: Block-PP/Elastomer/Talc (73/18/9 by wt))

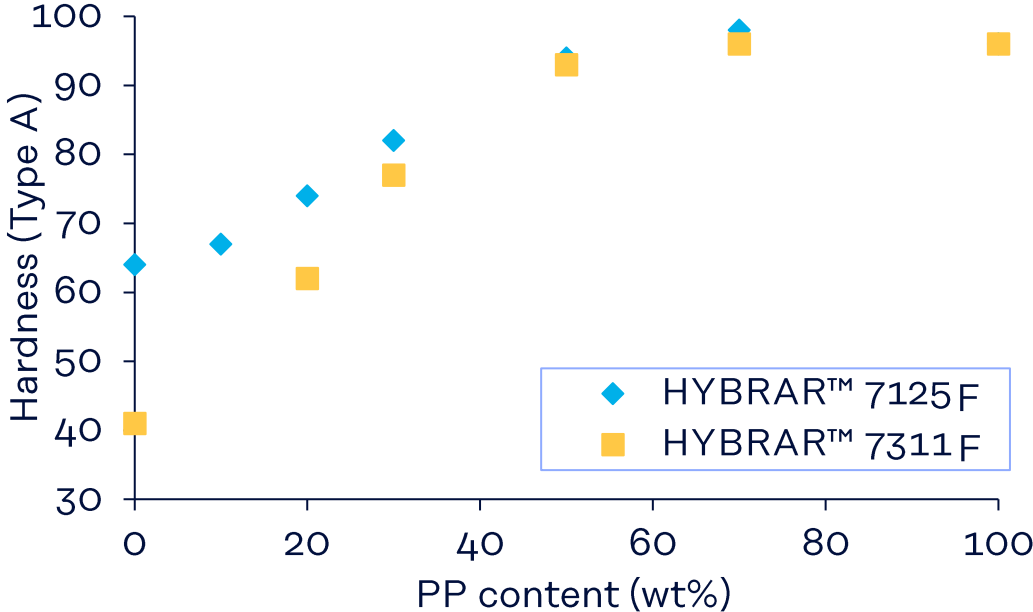
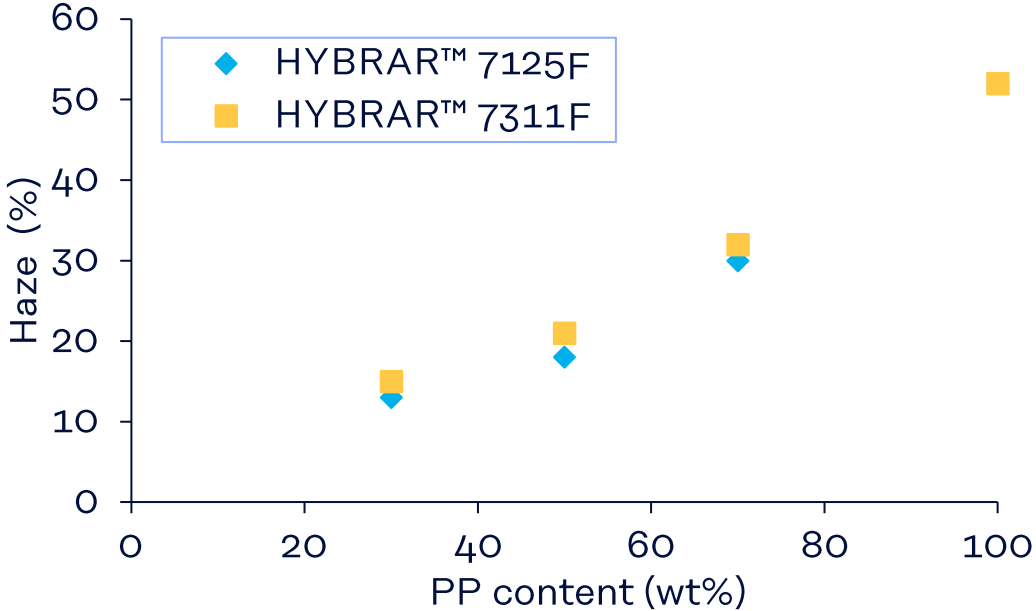


Random-PP Modification using HYBRAR™

Formulations	phr	Random-PP/ HYBRAR™ 7125F			Random-PP/ HYBRAR™ 7311F			Random-PP
HYBRAR™ 7125F		70	50	30				
HYBRAR™ 7311F					70	50	30	
Random-PP		30	50	70	30	50	70	100
Antioxidant		0.1	0.1	0.1	0.1	0.1	0.1	
Properties								
Hardness	Type A	82	94	98	77	93	96	
100% Modulus	MPa	3.6	7.5	12	3.0	6.4	10	
Tensile Strength	MPa	27	24	25	16	21	25	
Elongation	%	790	780	780	930	930	810	
Haze (1mmt sheet)	%	13	18	30	15	21	32	52

Random-PP : MFR=7 g/10 min

Random-PP Modification using HYBRAR™



PP Modification using SEPTON™ 2004F

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Typical Properties of SEPTON™ 2004F

		SEPTON™ 2004F	Test Method
Type		SEPS	
Styrene Content	wt%	18	
Specific Gravity		0.89	ISO 1183
Hardness (Type A)		67	ISO 7619
Properties			
100 % Modulus	MPa	2.2	
Tensile Strength	MPa	16	ISO 37 as reference
Elongation	%	690	
MFR (230 deg. C, 2.16 kg)	g/10 min.	5	ISO 1133 as reference
Solution Viscosity (15 wt%)	mPa·s	145	Toluene Solution, at 30 deg. C
Physical Form		Pellet	

Properties of SEPTON™ 2004F/Block-PP

Preparation of Test Specimen

Material	SEPTON™ 2004F Block-PP (MFR=30 g/10 min)
Formulations	Block-PP/SEPTON™ 2004F (100/0, 90/10, 80/20, 70/30 by wt) (Antioxidant: 0.1 phr)
Mixing	Twin Screw Extruder D=25 mm, L/D=25 mm/mm Temperature 230 deg. C, Screw Rotation 100 rpm
Molding	Injection Molding, Temperature 230 deg. C

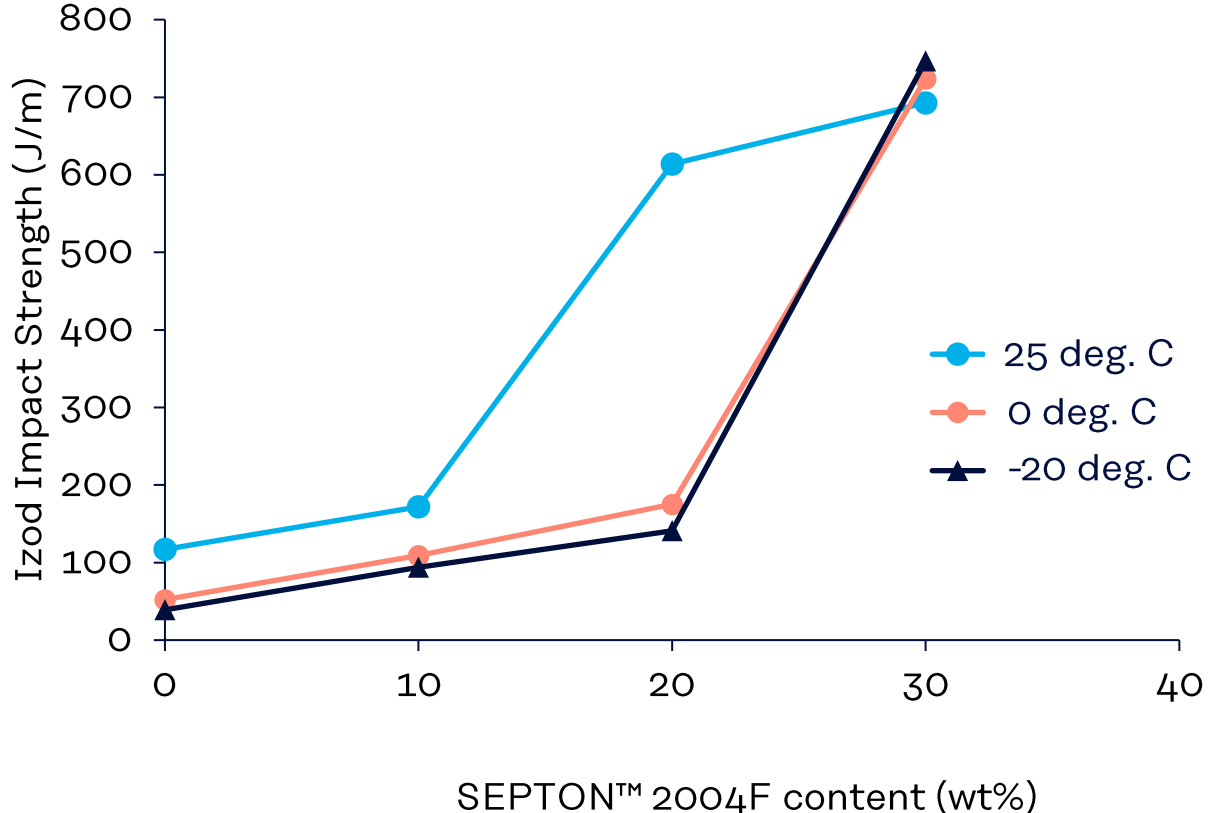
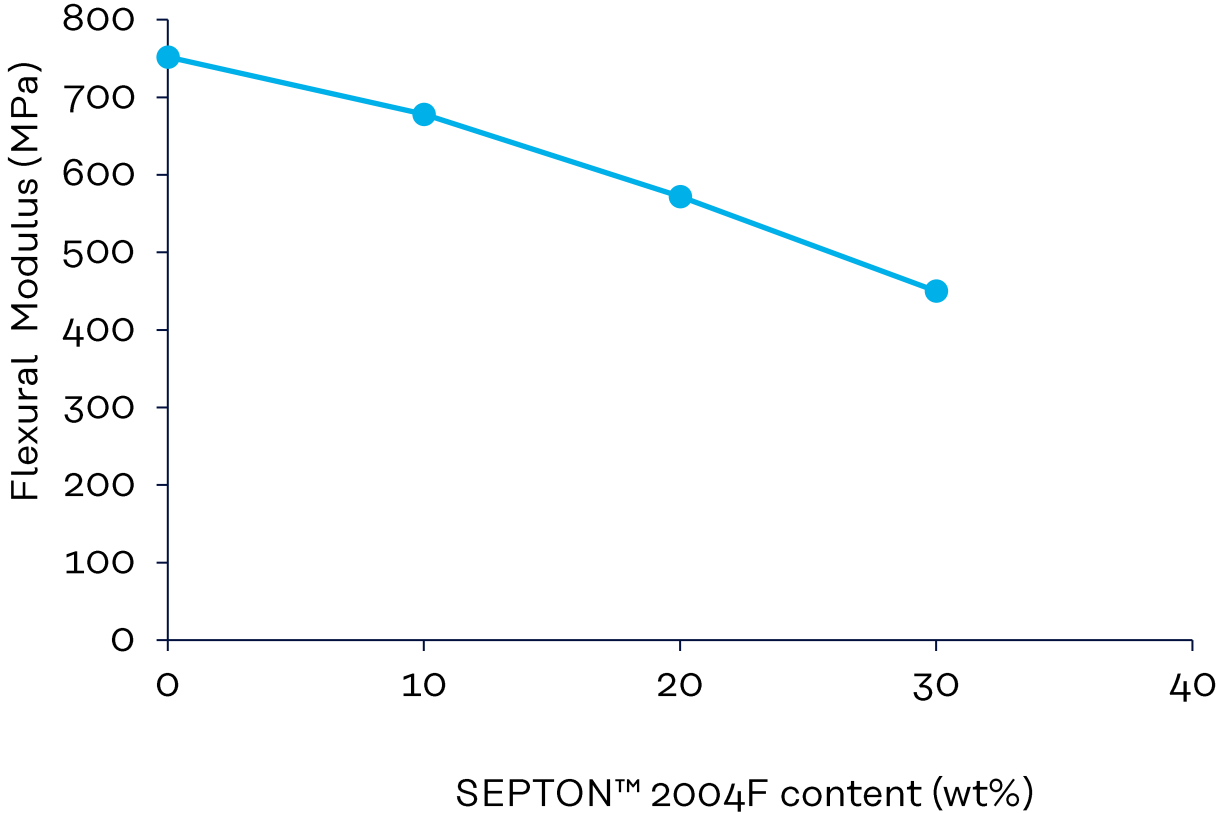
Test method

Flexural Properties	ISO 178 as reference
Izod Impact Strength	ISO 180 as reference (Notched)

Properties of SEPTON™ 2004F/Block-PP

		1	2	3	4
Formulations	phr				
SEPTON™ 2004F			10	20	30
Block-PP		100	90	80	70
Properties					
Flexural Modulus	(MPa)	752	678	572	450
Flexural Strength	(MPa)	24	21	18	15
Izod Impact Strength					
at 25 deg. C	(J/m)	117	172	614	693
at 0 deg. C	(J/m)	52	109	175	724
at -20 deg. C	(J/m)	39	94	141	747

Properties of SEPTON™ 2004F/Block-PP



SEPTON™ 2004F improves the impact resistance of PP.

PS/PP Modification using SEPTON™

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Formulations and Properties

		1	2
Formulations	phr		
GPPS		70	68
Homo-PP (MFR = 10)		30	29
SEPTON™ 2104 (SEPS)			3
Properties			
Flexural modulus	MPa	2,500	2,380
Yield point stress	MPa	56	66
Yield point strain	mm	3.8	5.3
Notched impact strength, at 25 deg. C	J/m	22	18

Test methods

Bending strength: JIS K 7171 as reference
 Bending speed 2 mm/min,
 Temperature; 25 deg. C

Notched impact strength: JIS K 7110 as reference
 Mold notch, Thickness 3.2 mm,
 Temperature; 25 deg. C

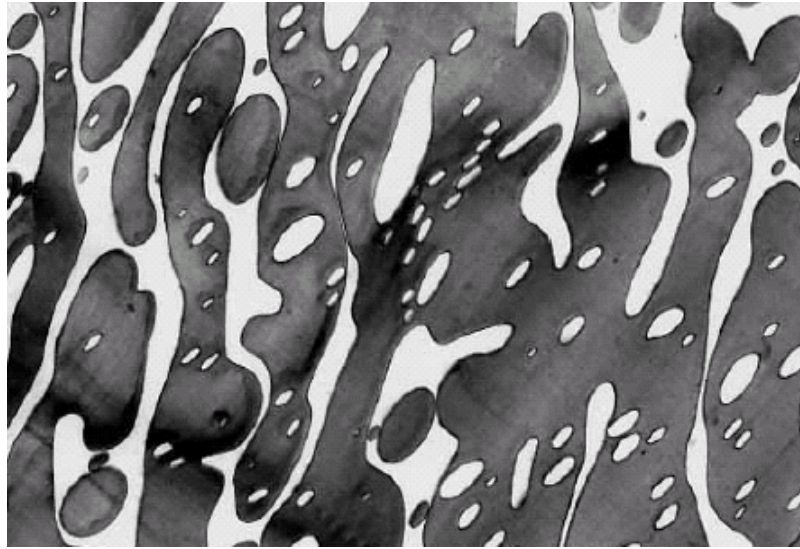
Material

GPPS: MFR 7.5 g/10 min (200 deg. C, 5 kg)
 Homo-PP: MFR 10 g/10 min (230 deg. C, 2.16 kg)

Adding SEPTON™ 2104 improves compatibility between GPPS and PP which enhances toughness.

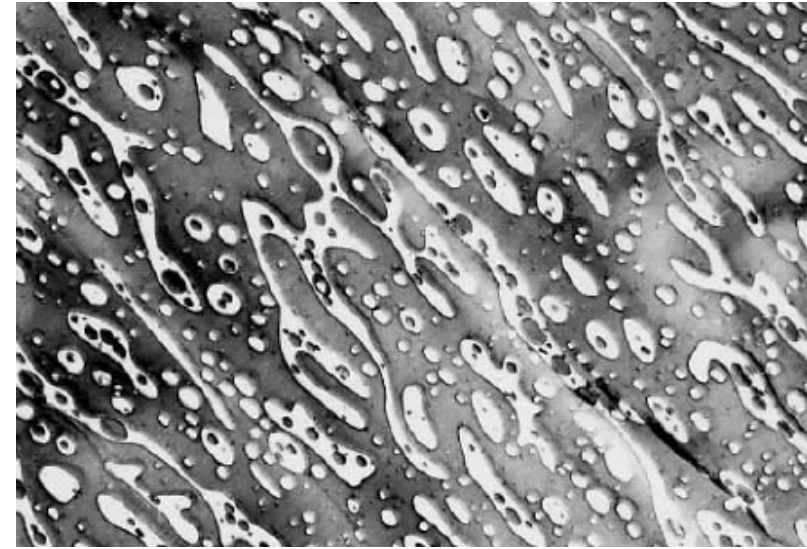
Morphology - TEM (x 10,000) -

Gray: GPPS
White: Homo-PP



1 μm

GPPS/Homo-PP
(70/30 by wt)



1 μm

GPPS/Homo-PP/SEPTON™ 2104
(68/29/3 by wt)

Using SEPTON™ 2104 increases PP dispersion.

Polycarbonate Modification using SEPTON™

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Raw Materials used in the Experiments

*Melt volume-flow rate

◆ Polycarbonate

PC-1: Standard grade, MVR* (300 deg. C, 1.20 kg)= 8 cm³/10 min

PC-2: Standard grade, MVR (300 deg. C, 1.20 kg)= 18 cm³/10 min

◆ Polypropylene

PP-1: Homo type, MFR (230 deg. C, 2.16 kg)= 0.7 g/10 min

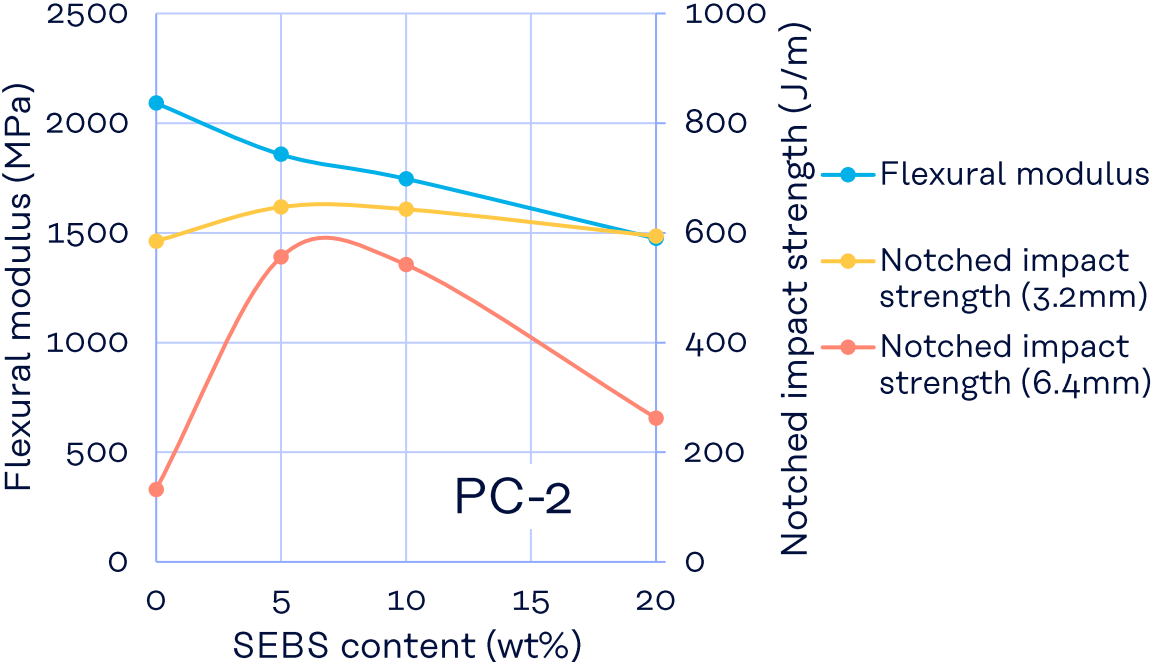
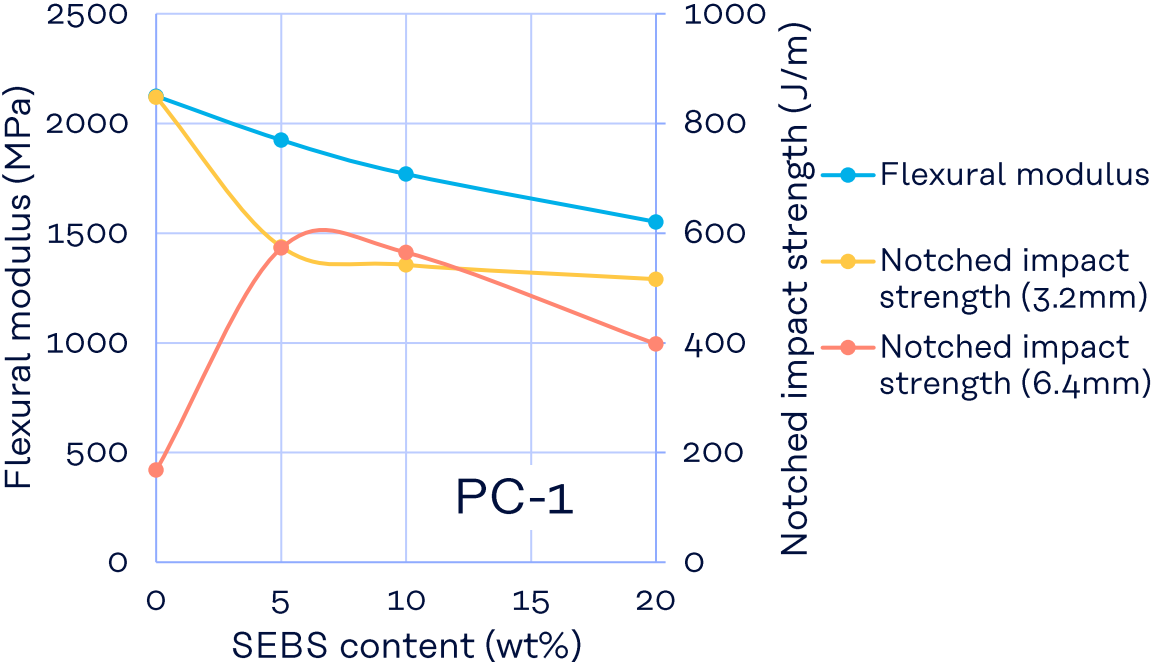
◆ HSBC

Grade	Type	Styrene content (wt%)	MFR (230 deg. C, 2.16 kg) (g/10 min)
SEPTON™ 8006	SEBS	33	No flow
SEPTON™ 2104	SEPS	65	0.4

PC Modification by SEBS (SEPTON™ 8006)

Formulations (wt%)	Tensile Strength (MPa)	Tensile modulus (MPa)	Elongation (%)	Flexural Strength (MPa)	Flexural Modulus (MPa)	Notched Impact Strength, (J/m)	
						3.2 mm	6.4 mm
PC-1/SEPTON™ 8006 (100/0)	58	2,140	96	108	2,120	848	168
(95/5)	59	1,870	118	70	1,920	575	573
(90/10)	56	1,810	121	64	1,770	542	565
(80/20)	50	1,360	126	55	1,550	516	398
PC-2/SEPTON™ 8006 (100/0)	65	2,230	113	76	2,090	585	132
(95/5)	63	2,150	131	67	1,860	647	556
(90/10)	59	2,020	126	62	1,750	643	542
(80/20)	49	1,750	123	52	1,480	594	262

PC Modification by SEBS (SEPTON™ 8006)



5-10% addition of SEBS (SEPTON™ 8006) improves the impact resistance of PC (thick plates).

PC Modification by SEBS (SEPTON™ 8006) or SEPS (SEPTON™ 2104)

Formulations (wt%)	Tensile Strength (MPa)	Tensile modulus (MPa)	Elongation (%)	Flexural Strength (MPa)	Flexural Modulus (MPa)	Notched Impact Strength (J/m)	
						3.2 mm	6.4 mm
PC-1 = 100	58	2,140	96	108	2,120	848	168
PC-1/SEPTON™ 8006 (95/5)	59	1,870	118	70	1,920	575	573
(90/10)	56	1,810	121	64	1,770	542	565
PC-1/SEPTON™ 2104 (95/5)	59	2,080	111	78	2,060	767	NB
(90/10)	66	2,000	123	78	2,070	829	510

High styrene content of SEPTON™ 2104 improves impact strength of PC while maintaining flexural modulus of PC.

PC/PP Modification by SEBS (SEPTON™ 8006) or SEPS (SEPTON™ 2104)

Formulations (wt%)	Tensile Strength (MPa)	Tensile modulus (MPa)	Elongation (%)	Flexural Strength (MPa)	Flexural Modulus (MPa)	Notched Impact Strength (J/m)	
						3.2 mm	6.4 mm
A1: PC-1/PP-1 (70/30)	42	1,880	10	46	1,550	144	120
A1/SEPTON™ 8006 (90/10)	39	1,770	16	48	1,440	398	395
A1/SEPTON™ 2104 (90/10)	53	1,610	119	55	1,550	963	433
(80/20)	54	2,010	142	55	1,560	858	398

SEPTON™ 2104 improves mechanical properties and impact strength of PC/PP blend.

ESCR of PC/PP/SEBS (SEPTON™ 8006) or SEPS (SEPTON™ 2104)

ESCR: Environmental Stress Cracking Resistance (ISO 4599 as reference)

Formulations (wt%)	ESCR (sec.)		Notched Impact Strength (J/m) (Immersed in acetone 300 sec.)	
	Acetone	Gasoline	3.2 mm	6.4 mm
PC-1 = 100	0	2	67	44
A1: PC-1/PP-1 (70/30)	>2,000	1	134	113
A1/SEPTON™ 8006 (90/10)	>2,000	>2,000	372	343
A1/SEPTON™ 2104 (90/10)	>2,000	>2,000	853	402

SEPTON™ improves ESCR of PC/PP blend.

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Precautions should be taken in handling and storage. Please refer to the appropriate Safety Data Sheet for further safety information. In using SEPTON™ and HYBRAR™, please confirm related laws and regulations, and examine its safety and suitability for the application.

For medical, health care and food contact applications, please contact your Kuraray representative for specific recommendations. Even so, users must conduct their own assessment, revisions, registrations as well rely in their own technical and legal judgment to establish the safety and efficacy of their compound and/or end product with SEPTON™ and HYBRAR™ for any application. SEPTON™ and HYBRAR™ should not be used in any devices or materials intended for implantation in the human body. Nothing contained herein constitutes a license to practice under any patent and it should not be construed as an inducement to infringe any patent and the user is advised to take appropriate steps to be sure that any proposed use of the product will not result in patent infringement.

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