No. RRS03-001-E1

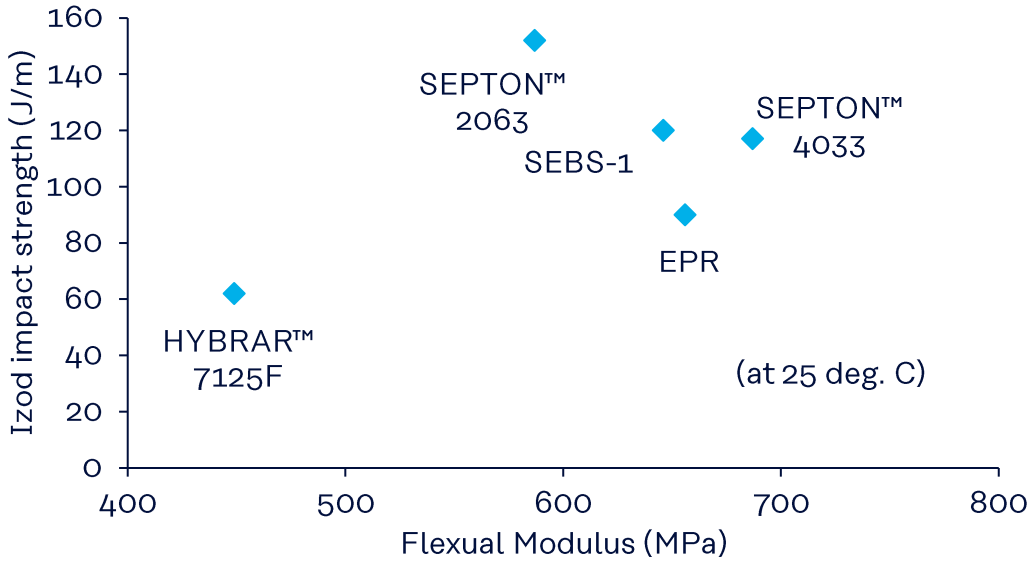
PP Modification using SEPTON™ and HYBRAR™

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
SEBS-1	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

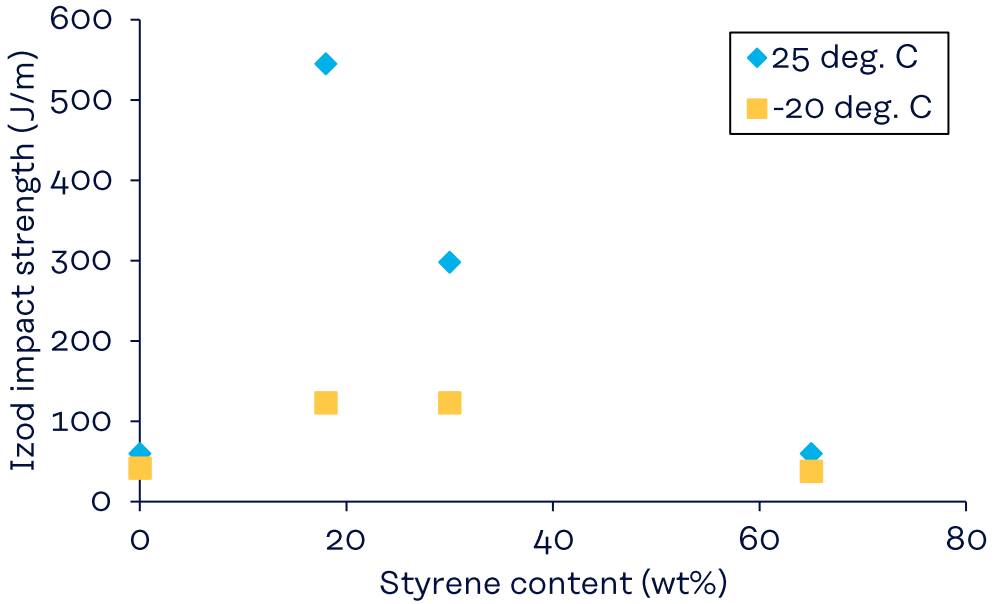
HYBRAR™

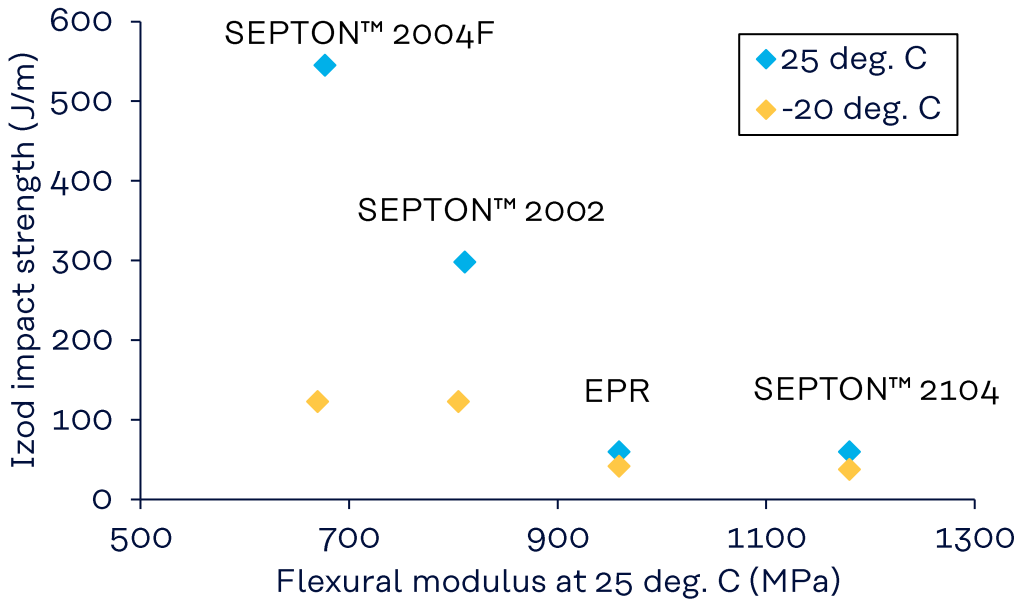
Good softening effect

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))



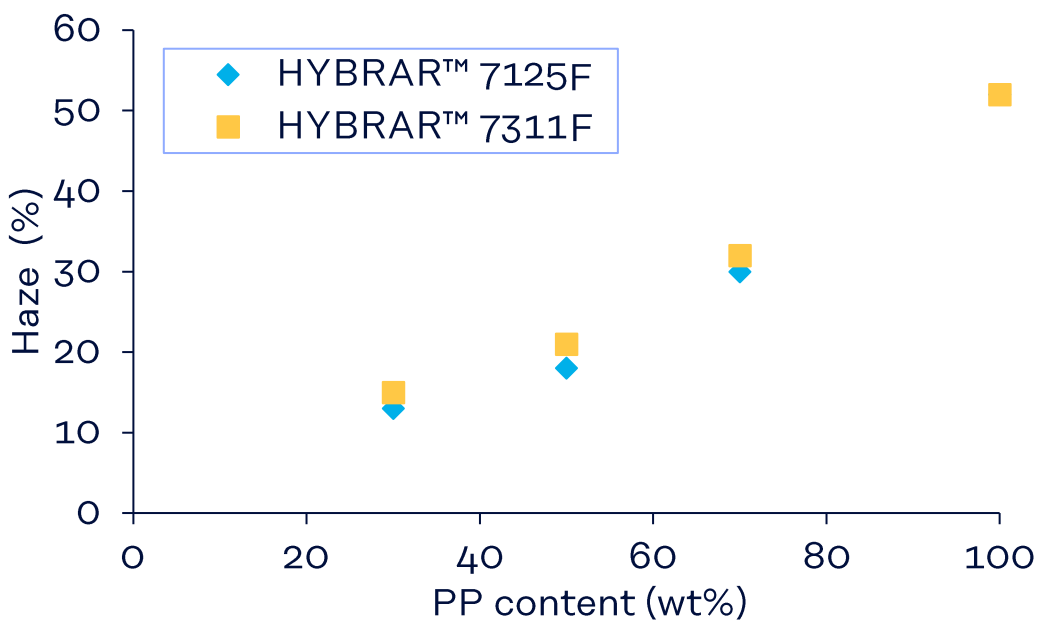


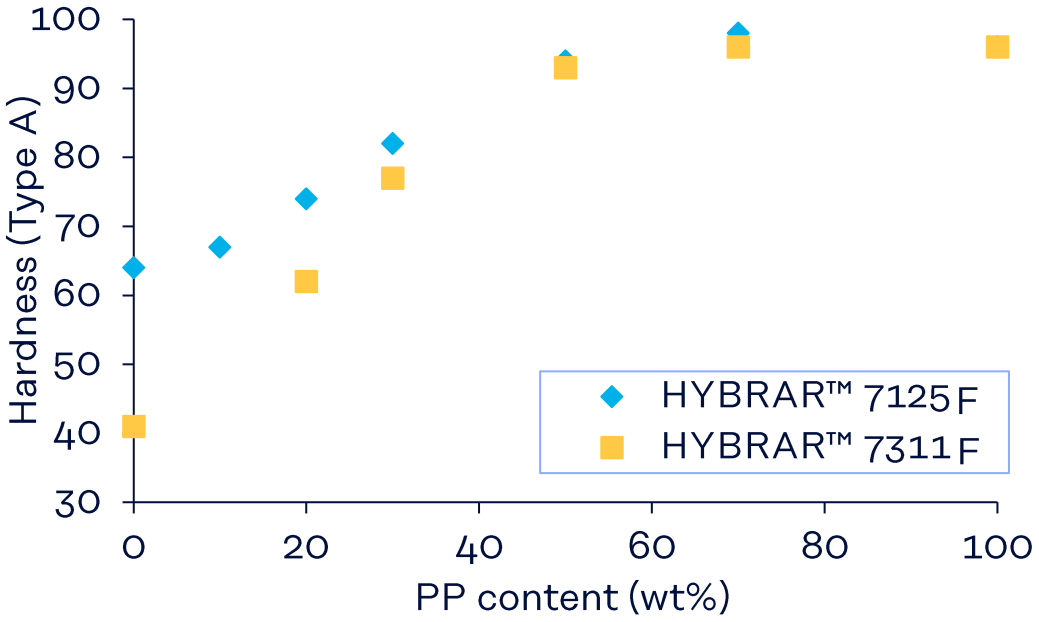
Random-PP Modification using HYBRAR™

		Random-PP/ HYBRAR™ 7125F			Random-PP/ HYBRAR™ 7311F			Random-PP
Formulations	phr							
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™





No. RRS03-002-E1

PP Modification using SEPTON™ 2004F

Elastomer R&D Dept.
Elastomer Division

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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	ISO 37 as reference
Tensile Strength	MPa	16	
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

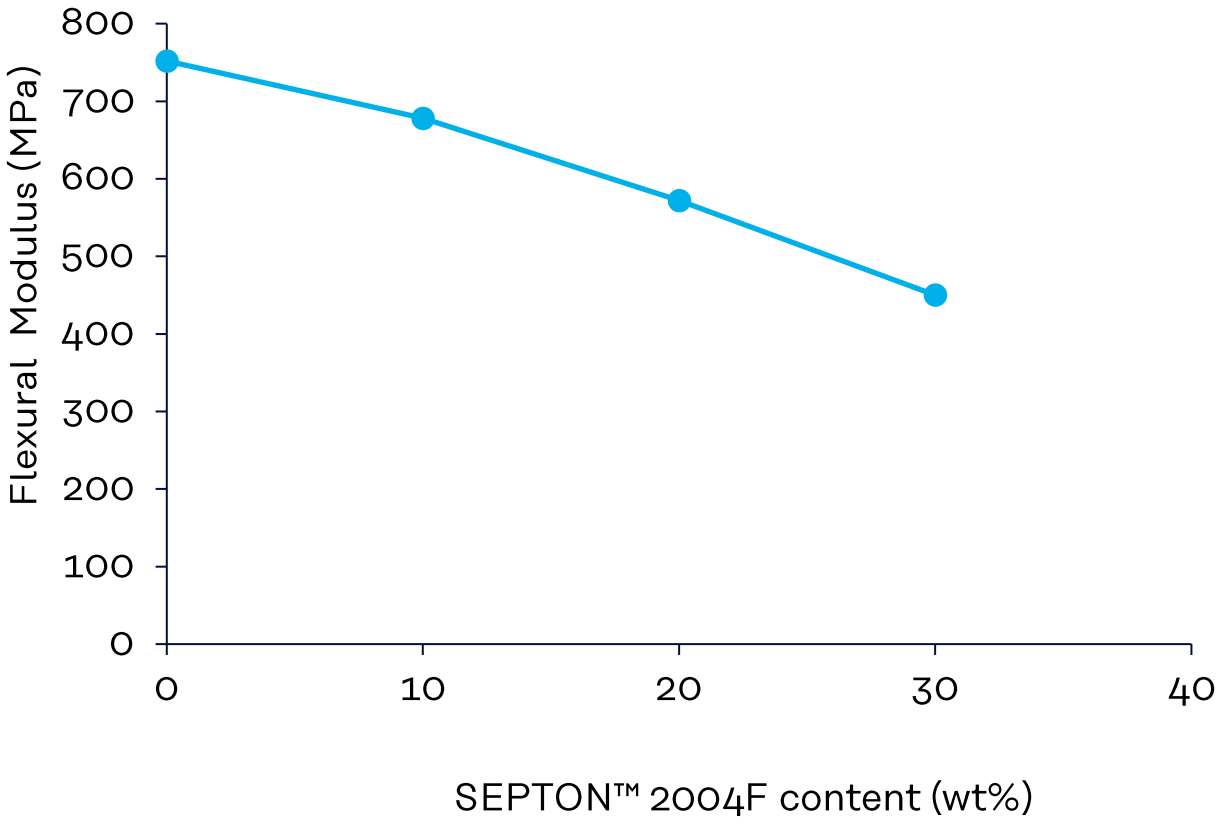
Test method

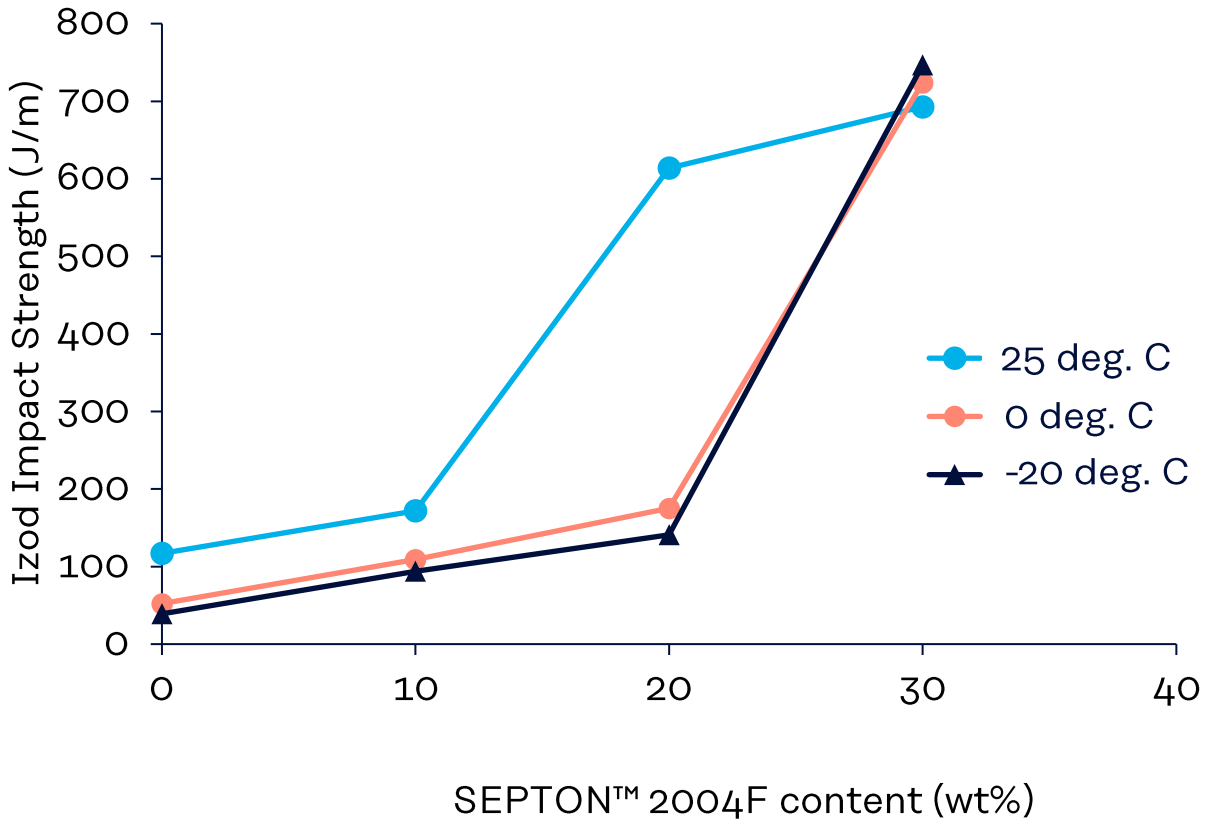
Flexural Properties	ISO 178 as reference
Izod Impact Strength	ISO 180 as reference (Notched)

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.

RRS03-005-E1

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

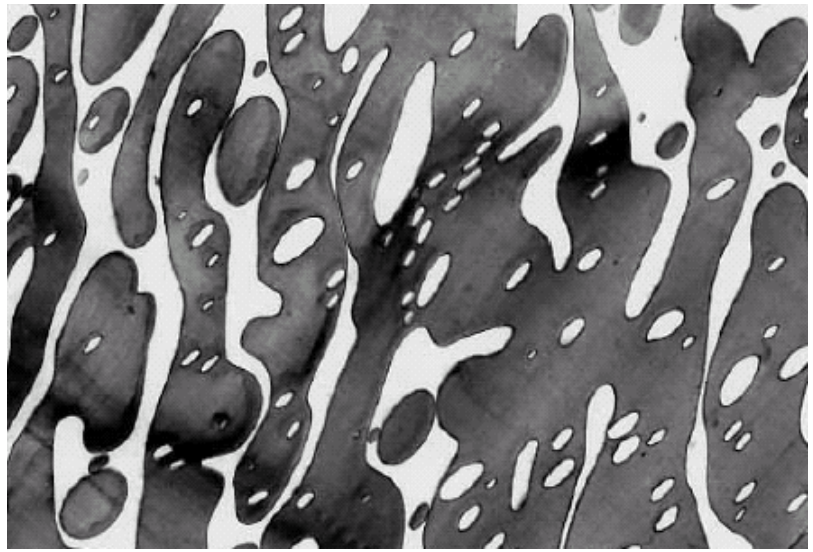
Notched impact strength: JIS K 7110 as reference
Mold notch, Thickness 3.2 mm,
Temperature; 25 deg. C

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)

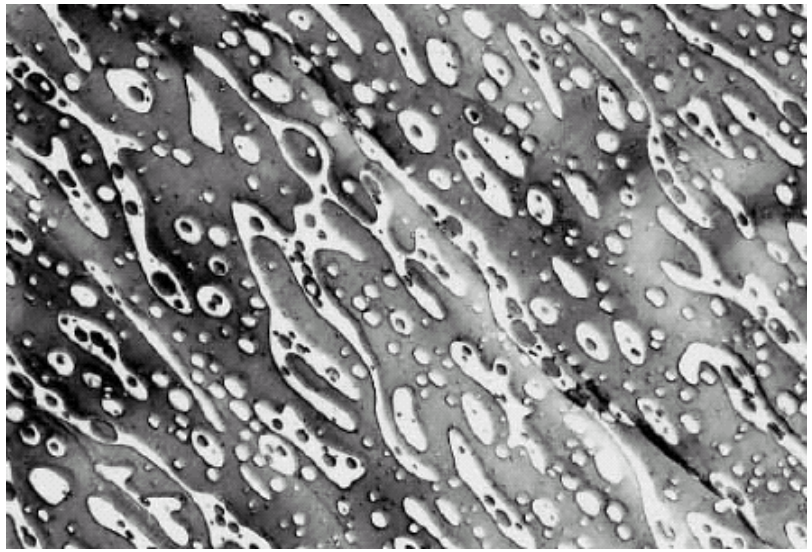
Adding SEPTON™ 2104 improves compatibility between GPPS and PP which enhances toughness.

Morphology - TEM (x 10,000) -

Gray: GPPS
White: Homo-PP



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



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

Using SEPTON™ 2104 increases PP dispersion.

No. RRS03-003-E1

Polycarbonate Modification using SEPTON™

Elastomer R&D Dept.
Elastomer Division

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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 cm^3/10 min
  PC-2: Standard grade, MVR (300 deg. C, 1.20 kg)= 18 cm^3/10 min

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

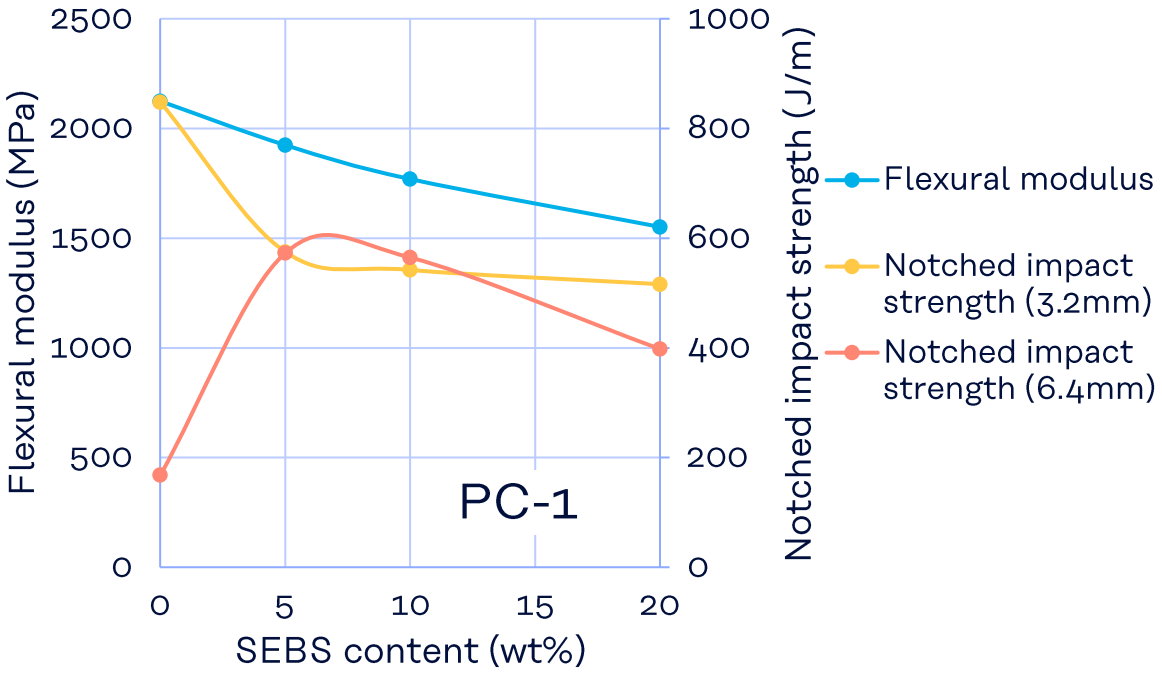
- HSBC

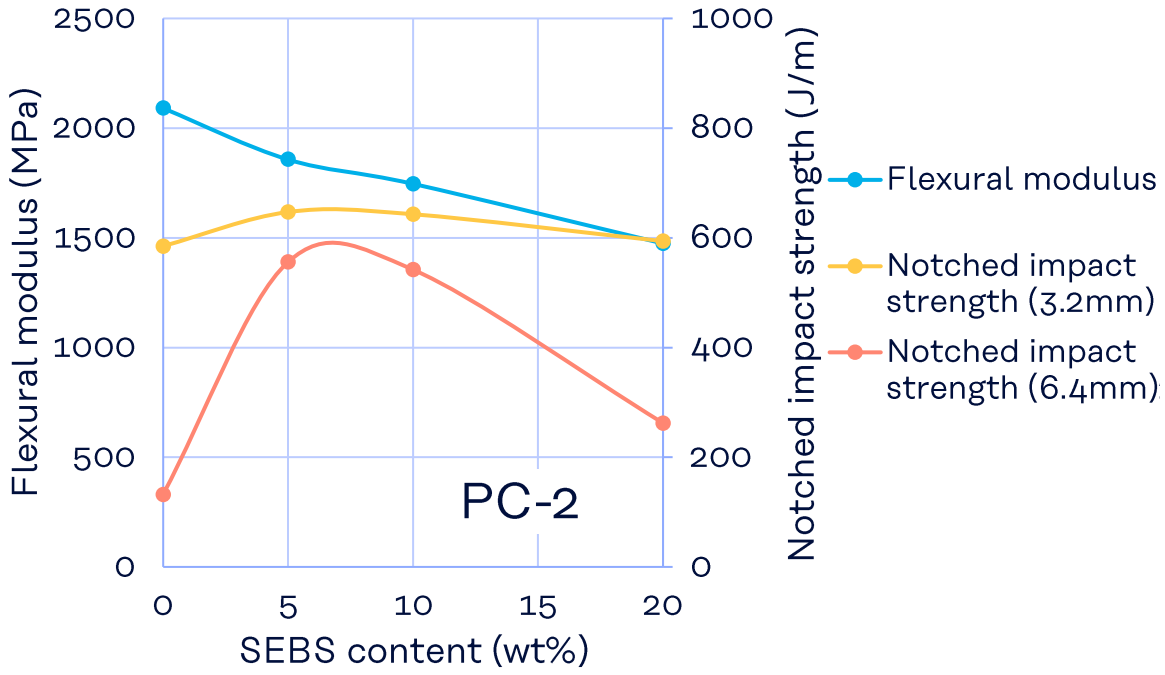
Grade	Type	Styrene content (wt%)	MFR (230 deg. C, 2.16 kg) (g/10 min)
SEPTON™ 8006	SEBS	33	No flow
SEPTON™ 2104	SEPS	65	0.4

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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