

Adhesive using SEPTON™

Elastomer R&D Dept.
Elastomer Division

kuraray **Septon™**

Experiment (1)

Raw Materials

Hydrogenated styrene block copolymers (HSBC)

SEPTON™ 2004F Styrene=18 wt%, SEPS

SEPTON™ 2063 Styrene=13 wt%, SEPS

SEBS-1 Styrene=13 wt%, SEBS/SEB

Tackifier resin Hydrogenated hydrocarbon resin
(ARKON P-100, Arakawa Chemical Industries, Ltd.)

Plasticizer Paraffin oil, kinematic viscosity=90 mm²/s at 40 deg. C

Antioxidant (AO) Irganox® 1010 (BASF Japan Ltd.)

Formulations

HSBC/Tackifier resin/Plasticizer (100/300/100, 100/200/100 by wt) (AO=0.1 phr/Compound)

Test Items and Conditions

Melt viscosity Brookfield viscometer

Tack* Ball tack method (JIS Z0237 as reference)

*Higher No (Ball) means higher tack properties

Creep test* 1 kg load, at 40 and 60 deg. C

Adhesion* 180° Peel strength to stainless steel and to polyethylene, 300 mm/min

*Solvent coating using toluene.

Test results (1)

			1	2	3	4	5	6
Formulations		phr						
SEPTON™ 2004F			100			100		
SEPTON™ 2063				100			100	
SEBS-1					100			100
Tackifier resin			300	300	300	200	200	200
Plasticizer			100	100	100	100	100	100
AO			0.1	0.1	0.1	0.1	0.1	0.1
Properties								
Tack	Ball tack	Ball No.	<2	<2	<2	13	22	13
180° Peel Strength	to stainless steel	N/25 mm	34	24	27	17	22	15
	to polyethylene	N/25 mm	12	25	25	7	15	12
Creep test	40 deg. C,	Slippage, mm	6.5	-	-	2.1	-	-
	240 min	Time to failure, min	-	87	50	-	97	155
	60 deg. C,	Slippage, mm	-	-	-	-	-	-
	240 min	Time to failure, min	10	1	4	21	2	7
Melt viscosity	140 deg. C	mPa·s	12,000	7,000	17,000	16,000	11,000	25,000
	160 deg. C	mPa·s	4,700	2,900	7,100	7,200	4,800	12,000
	180 deg. C	mPa·s	2,200	1,400	3,500	3,600	2,400	6,200
	200 deg. C	mPa·s	1,200	790	2,000	2,000	1,400	3,500

- ✓ Adhesives using SEPTON™ 2004F or 2063 exhibit a good balance of tack, adhesion, creep, and viscosity.
- ✓ Low melt viscosity formulations using SEPTON™ are suitable for hot-melt adhesives.

Experiment (2)

Raw Materials

	Hydrogenated styrene block copolymers (HSBC)
	SEPTON™ 2063 Styrene = 13 wt%, SEPS
	SEBS-2 Styrene = 30 wt%
Tackifier resin	Hydrogenated hydrocarbon resin (ARKON P-100 (Arakawa Chemical Industries, Ltd.))
Plasticizer	Paraffin oil, kinematic viscosity = 90 mm ² /s at 40 deg. C
Antioxidant(AO)	Irganox® 1010 (BASF Japan Ltd.)

Formulations (by wt)

- No.1 HSBC/Tackifier resin/Plasticizer (100/100/50) (AO 0.1 phr / Compound)
- No.2 HSBC/Tackifier resin/Plasticizer (100/150/50) (AO 0.1 phr / Compound)
- No.3 HSBC/Tackifier resin/Plasticizer (100/200/50) (AO 0.1 phr / Compound)

Test Items and Conditions

Melt viscosity	Brookfield viscometer
Tack*	Ball tack method (JIS Z0237 as reference) *Higher No (Ball) means higher tack properties
Creep test*	1 kg load, at 60 deg. C
Adhesion*	180° Peel strength to stainless steel and to polyethylene, 300 mm/min

*Solvent coating using toluene.

Test results (2)

			No.1		No.2		No.3	
Formulations		phr						
SEPTON™ 2063			100		100		100	
SEBS-2				100		100		100
Tackifier resin			100	100	150	150	200	200
Plasticizer			50	50	50	50	50	50
Antioxidant			0.1	0.1	0.1	0.1	0.1	0.1
Properties								
Tack	Ball tack	Ball No.	12	9	7	6	<2	<2
180° Peel Strength	to stainless steel	N/25 mm	10	5	17	17	29	16
	to polyethylene	N/25 mm	10	3	15	10	21	11
Creep test	60 deg. C, 240 min	Slippage, mm	-	0.3	-	0.6	-	1.0
		Time to failure, min	99	-	51	-	22	-
Melt viscosity	160 deg. C	mPa·s	44,200	137,000	21,700	38,500	13,400	19,200
	180 deg. C	mPa·s	16,600	35,800	10,400	12,500	6,450	7,050

✓ Adhesives using SEPTON™ 2063 show good adhesion and low viscosity.

Experiment (3)

Raw Materials

Styrenic block copolymers (SBC)

SEPTON™ 2005 Styrene = 20 wt%, SEPS

SEPTON™ 4033 Styrene = 30 wt%, SEEPS

SEPTON™ 4044 Styrene = 32 wt%, SEEPS

SEPTON™ 4077 Styrene = 30 wt%, SEEPS

SIS Styrene = 22 wt%, SIS/SI (SI=66%)

Tackifier resin (To HSBC) Hydrogenated hydrocarbon resin, ARKON P-100 (Arakawa Chemical Industries, Ltd.)
(To SIS) Aliphatic Hydrocarbon resin, Escorez™ 1310 (Exxon Mobil Corporation)

Plasticizer (To HSBC) Paraffin oil, kinematic viscosity=90 mm²/s at 40 deg. C
(To SIS) Naphthenic oil, kinematic viscosity=98 mm²/s at 40 deg. C

Antioxidant(AO) Irganox® 1010 (BASF Japan)

Formulations (by wt)

SBC/Tackifier resin/Plasticizer (100/150/100, 100/200/100, 100/300/100) (AO=0.1 phr/Compound)

Test Item and Conditions

Tack* Ball tack method (JIS Z0237 as reference)

* Higher No (Ball) means higher tack properties

Cohesion* Creep test 1 kg load, at 60 deg. C

Adhesion* 180° Peel strength to stainless steel and to polyethylene, 300 mm/min

*Solvent coating using toluene.

Test results (3)

Formulations: SBC/Tackifier resin/Plasticizer (100/300/100 by wt)

		SEPTON™				SIS
		2005	4033	4044	4077	
Tack						
Ball Tack	Ball No.	<3	<3	<3	<3	7
Probe Tack	N	15	5	12	6	7
Creep test						
60 deg. C, 240 min	Slippage, mm	0.2	-	0.5	0.3	-
	Time to failure, min	-	201	-	-	14
180° Peel Strength						
to stainless steel	N/25 mm	27	22	28	25	24
to polyethylene	N/25 mm	18	16	18	19	21
to glass	N/25 mm	24	5	27	9	22

Adhesive using SEPTON™ 2005 shows good performance.

Test results (3)

		1	2	3	4	5	6
Formulations	phr						
SEPTON™ 2005		100	100	100			
SIS					100	100	100
Tackifier resin		150	200	300	150	200	300
Plasticizer		100	100	100	100	100	100
AO		0.1	0.1	0.1	0.1	0.1	0.1
Tack (at 25 deg. C)							
Ball Tack	Ball No.	24	12	<3	23	20	7
Probe Tack	N	4	8	15	5	6	7
Creep test							
60 deg. C, 240 min	Slippage, mm	0.2	0.2	0.2	-	-	-
	Time to failure, min	-	-	-	26	15	14
180° Peel Strength							
to stainless steel	N/25 mm	10	17	27	17	18	24
to polyethylene	N/25 mm	9	16	18	14	15	21
to glass	N/25 mm	7	17	24	10	17	22
Solution Viscosity							
23 deg.C	mPa·s	1,200	670	270	240	140	90

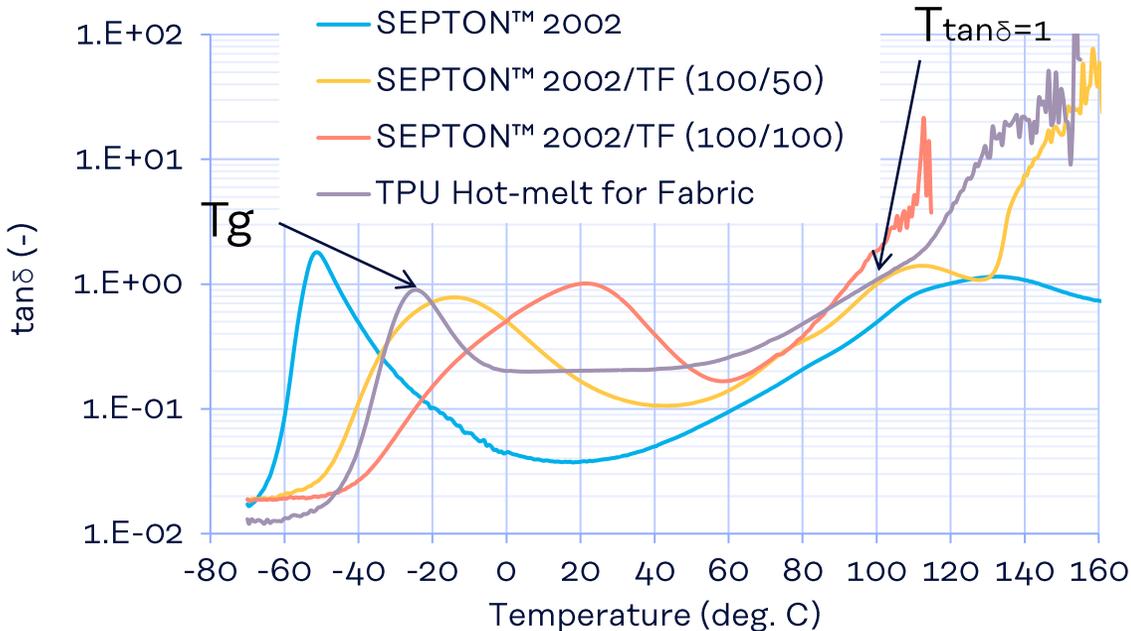
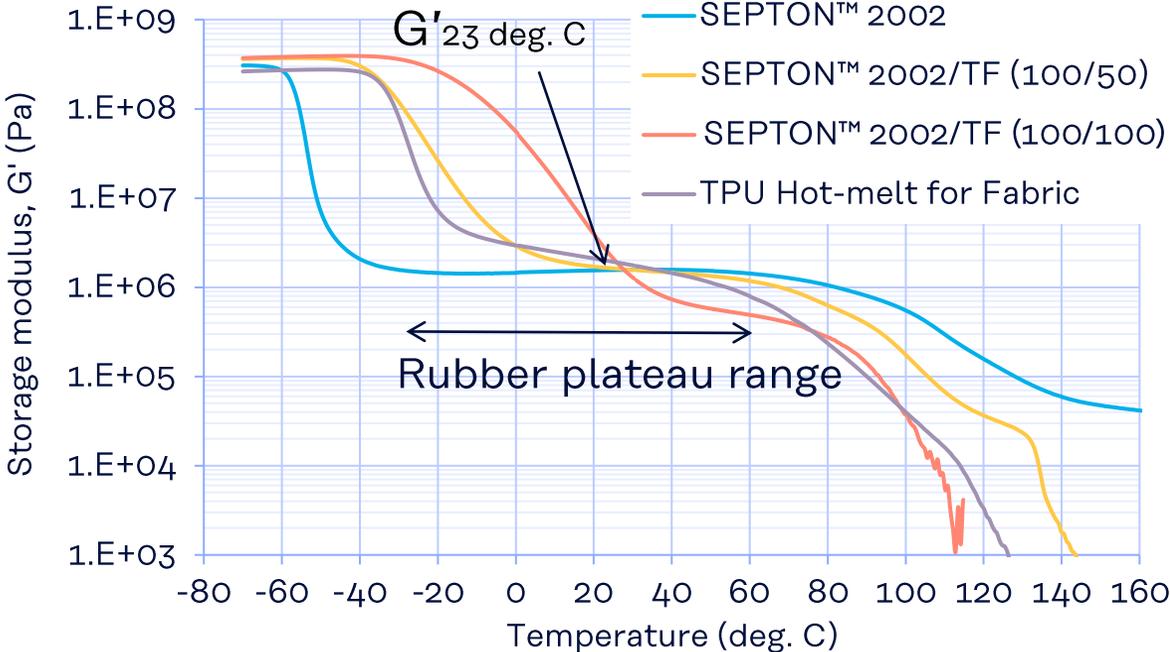
Adhesives using SEPTON™ 2005 show much higher cohesive force than adhesives using SIS.

Hot-Melt Adhesive using SEPTON™ for Fabric

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Dynamic Mechanical Properties: SEPTON™ 2002/Tackifier vs. TPU Hot-melt

- Tg and melt temperature of SEPTON™ 2002 can be changed by Tackifier resin (TF) amount.
- SEPTON™ 2002/TF (100/50 by wt) has similar properties to TPU hot-melt.

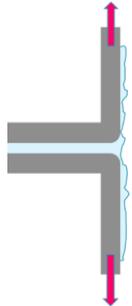


TF: Tackifier resin, Hydrogenated hydrocarbon resin (ARKON P-100, Arakawa Chemical Industries, Ltd.)
 TPU Hot-melt for fabric: Ester type, Melting point=115 deg. C, Hardness=75A

Hot-melt Adhesive Properties for Fabric

		SEPTON™ 2002/ARKON P-100 (100/50 by wt)	TPU Hot-melt for Fabric
Adhesive Sheet Thickness	μm	100	100
Peel Strength to Fabric*	N/25 mm	59	63

* Fabric composition :Cotton 66%, Polyester 34%
 Peel test condition: 145 deg. C, 30 sec, 0.06 MPa, 100 mm/min, T-peel

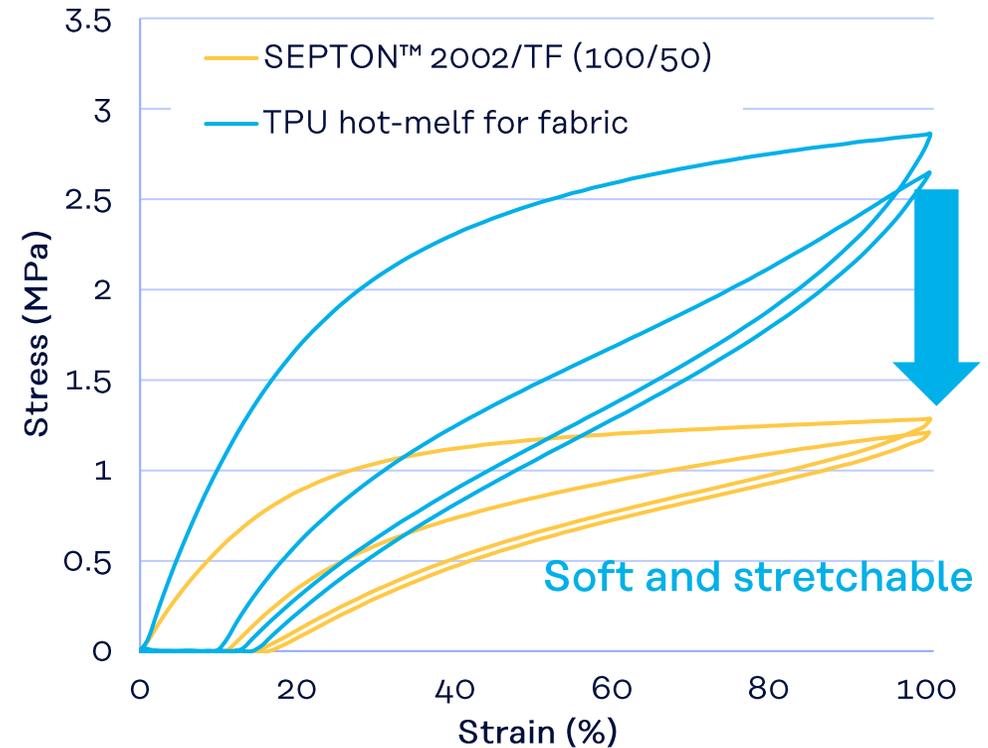


Light gray: Fabric
 Right blue: Adhesive

Hardness and Tensile Properties: SEPTON™ 2002/Tackifier vs. TPU Hot-melt

SEPTON™ 2002/TF (100/50 by wt) adhesives provide lower modulus than TPU hot-melt.
=> Soft and stretchable adhesives, suitable for fabric applications.

		1	2	3	4	
Formulations (phr)						
SEPTON™ 2002	SEPS, Styrene=30%, MFR=70	100	100	100		
TF			50	100		
TPU Hot-melt for Fabric					100	
Properties						
Hardness	Type A	75	60	60	68	
Tensile hysteresis test	Hysteresis loss-1	%	32.6	43.2	69.0	47.9
	Hysteresis loss-2	%	9.1	24.5	62.1	22.9
	M100 (1st-tensile)	MPa	3.03	1.29	0.87	2.86



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