복합재료(Composite+PET) 물성 DB (200개)

ㅇ 시험 개요

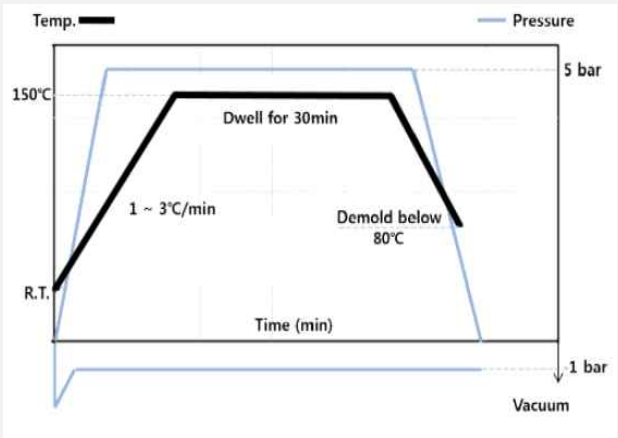
탄소섬유 강화 복합재료에 대한 시뮬레이션 물성 라이브러리를 구축하기 위해, 다양한 복합구조체의 섬유 방향과 적층수와 수지 종류에 따른 재료 물성 차이를 조사하고, 이에 따른 결과를 데이터 베이스(Data Base, DB) 구축하는 것이 목적임.

ㅇ 시험규격 (ASTM D3039, ASTM D695, ASTM D5379)

시험 장비는 20톤 용량의 Shimadzu사 만능재료시험기를 사용하여 재료 물성을 평가하였으며, 하중 변위 속도는 분당 2mm의 변위제어 속도로 최대 하중의 50% 하중 저하가 발생하면 자동으로 종료되도록 설정함.

ㅇ 성형 조건 및 시험 환경

시험환경은 대기온도 25℃, 습도 20%에서 시험.



<성형조건>

ㅇ 시험장비(만능재료시험기)

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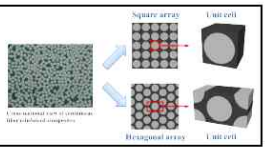
Data base report of material properties library for polymer composite engineering

■ Theory

Representative elementary volume (RVE) is the smallest volume over which a measurement can be made that will yield a value representative of the whole. In the case of periodic materials, one simply chooses a periodic unit cell (which, however, may be non-unique), but in random media, the situation is much more complicated.



■ Material properties

☐ Weave

Brand	SK Chemical
Pattern	Woven
Fiber material	Carbon
Lay up type	Multi layer

☐ Material properties

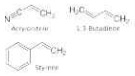
Property	Unit	Value
E-Modulus	GPa	117
Poisson's ratio	-	0.28
Density	g/mm³	1.87

☐ Resin

Type	PET

☐ Material properties

Property	Unit	Value
E-Modulus	MPa	495
Poisson's ratio	-	0.28
Density	g/mm³	1.76



■ Property according to direction(XYZ)

No.	Symbol	Properties	Unit	Value	Notes
1	ρ	Density	g/mm³	1.859E-09	-
2	E_1	Young's Modulus X	MPa	151723	Longitudinal modulus
3	E_2	Young's Modulus Y	MPa	9985.36	Transverse Modulus
4	E_3	Young's Modulus Z	MPa	13616.4	-
5	ν_{12}	Poisson's ratio XY	MPa	0.4049445	-
6	ν_{13}	Poisson's ratio YZ	MPa	0.566136	-
7	ν_{23}	Poisson's ratio XZ	MPa	0.3531156	-
8	G_{12}	Shear Modulus XY	MPa	4789.113	In-plane shear modulus
9	G_{13}	Shear Modulus YZ	MPa	3681.427	Out-of-plane shear modulus
10	G_{23}	Shear Modulus XZ	MPa	4391.644	Out-of-plane shear modulus
11	S_{1T}	Longitudinal Tensile strength	MPa	5146.911	Strain: 0.03%
12	S_{1C}	Longitudinal Compressive strength	MPa	-3956.469	Strain: 0.03%
13	S_{2T}	Transverse Tensile strength	MPa	4003.251	Strain: 0.03%
14	S_{2C}	Transverse compressive strength	MPa	-392.1552	Strain: 0.03%
15	S_{3T}	Tensile strength	MPa	359.4756	Strain: 0.03%
16	S_{3C}	Compressive strength	MPa	-394.8785	Strain: 0.03%
17	S_{12}	Out-of-plane shear strength	MPa	149.9256	-
18	S_{23}	Shear strength	MPa	113.58	-
19	k	Thermal conductivity	W/m·K	390.5975	
20	C_p	Specific heat	kJ/kg·K	404.775	

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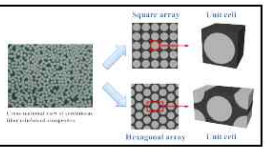


■ Material properties

☐ Weave

Brand	SK Chemical
Pattern	Woven
Fiber material	Carbon
Lay up type	Multi layer

☐ Material properties

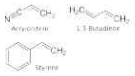
Property	Unit	Value
E-Modulus	GPa	122
Poisson's ratio	-	0.25
Density	g/mm³	1.86

☐ Resin

Type	PET

☐ Material properties

Property	Unit	Value
E-Modulus	MPa	425
Poisson's ratio	-	0.25
Density	g/mm³	1.74



■ Property according to direction(XYZ)

No.	Symbol	Properties	Unit	Value	Notes
1	ρ	Density	g/mm³	2.102E-09	-
2	E_1	Young's Modulus X	MPa	122545.5	Longitudinal modulus
3	E_2	Young's Modulus Y	MPa	9803.808	Transverse Modulus
4	E_3	Young's Modulus Z	MPa	9440.704	-
5	ν_{12}	Poisson's ratio XY	MPa	0.5857935	-
6	ν_{13}	Poisson's ratio YZ	MPa	0.526821	-
7	ν_{23}	Poisson's ratio XZ	MPa	0.2757204	-
8	G_{12}	Shear Modulus XY	MPa	4039.796	In-plane shear modulus
9	G_{13}	Shear Modulus YZ	MPa	3844.322	Out-of-plane shear modulus
10	G_{23}	Shear Modulus XZ	MPa	5678.85	Out-of-plane shear modulus
11	S_{1T}	Longitudinal Tensile strength	MPa	4306.599	Strain: 0.03%
12	S_{1C}	Longitudinal Compressive strength	MPa	-4796.781	Strain: 0.03%
13	S_{2T}	Transverse Tensile strength	MPa	3649.222	Strain: 0.03%
14	S_{2C}	Transverse compressive strength	MPa	-275.0533	Strain: 0.03%
15	S_{3T}	Tensile strength	MPa	356.7523	Strain: 0.03%
16	S_{3C}	Compressive strength	MPa	-288.6698	Strain: 0.03%
17	S_{12}	Out-of-plane shear strength	MPa	118.1232	-
18	S_{23}	Shear strength	MPa	166.9626	-
19	k	Thermal conductivity	W/m·K	360.029	
20	C_p	Specific heat	kJ/kg·K	555.12	

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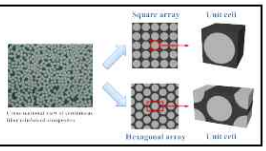


■ Material properties

☐ Weave

Brand	SK Chemical
Pattern	Woven
Fiber material	Carbon
Lay up type	Multi layer

☐ Material properties

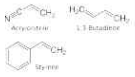
Property	Unit	Value
E-Modulus	GPa	104
Poisson's ratio	-	0.27
Density	g/mm³	1.86

☐ Resin

Type	PET

☐ Material properties

Property	Unit	Value
E-Modulus	MPa	426
Poisson's ratio	-	0.29
Density	g/mm³	1.88



■ Property according to direction(XYZ)

No.	Symbol	Properties	Unit	Value	Notes
1	ρ	Density	g/mm³	2.044E-09	-
2	E_1	Young's Modulus X	MPa	127213.9	Longitudinal modulus
3	E_2	Young's Modulus Y	MPa	11074.672	Transverse Modulus
4	E_3	Young's Modulus Z	MPa	9713.032	-
5	ν_{12}	Poisson's ratio XY	MPa	0.463917	-
6	ν_{13}	Poisson's ratio YZ	MPa	0.401013	-
7	ν_{23}	Poisson's ratio XZ	MPa	0.3240924	-
8	G_{12}	Shear Modulus XY	MPa	3844.322	In-plane shear modulus
9	G_{13}	Shear Modulus YZ	MPa	4886.85	Out-of-plane shear modulus
10	G_{23}	Shear Modulus XZ	MPa	4278.067	Out-of-plane shear modulus
11	S_{1T}	Longitudinal Tensile strength	MPa	4446.651	Strain: 0.03%
12	S_{1C}	Longitudinal Compressive strength	MPa	-4096.521	Strain: 0.03%
13	S_{2T}	Transverse Tensile strength	MPa	2804.999	Strain: 0.03%
14	S_{2C}	Transverse compressive strength	MPa	-277.7766	Strain: 0.03%
15	S_{3T}	Tensile strength	MPa	332.2426	Strain: 0.03%
16	S_{3C}	Compressive strength	MPa	-307.7329	Strain: 0.03%
17	S_{12}	Out-of-plane shear strength	MPa	148.7898	-
18	S_{23}	Shear strength	MPa	126.0738	-
19	k	Thermal conductivity	W/m·K	339.65	
20	C_p	Specific heat	kJ/kg·K	454.89	

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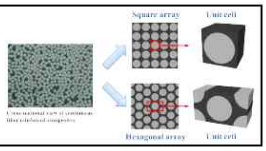


■ Material properties

☐ Weave

Brand	SK Chemical
Pattern	Woven
Fiber material	Carbon
Lay up type	Multi layer

☐ Material properties

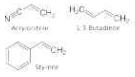
Property	Unit	Value
E-Modulus	GPa	126
Poisson's ratio	-	0.3
Density	g/mm³	1.74

☐ Resin

Type	PET

☐ Material properties

Property	Unit	Value
E-Modulus	GPa	391
Poisson's ratio	-	0.28
Density	g/mm³	1.8



■ Property according to direction(XYZ)

No.	Symbol	Properties	Unit	Value	Notes
1	ρ	Density	g/mm³	1.515E-09	-
2	E_1	Young's Modulus X	MPa	165728.2	Longitudinal modulus
3	E_2	Young's Modulus Y	MPa	11800.88	Transverse Modulus
4	E_3	Young's Modulus Z	MPa	13434.848	-
5	ν_{12}	Poisson's ratio XY	MPa	0.518958	-
6	ν_{13}	Poisson's ratio YZ	MPa	0.4521225	-
7	ν_{23}	Poisson's ratio XZ	MPa	0.2708832	-
8	G_{12}	Shear Modulus XY	MPa	4104.954	In-plane shear modulus
9	G_{13}	Shear Modulus YZ	MPa	3323.058	Out-of-plane shear modulus
10	G_{23}	Shear Modulus XZ	MPa	4543.08	Out-of-plane shear modulus
11	S_{1T}	Longitudinal Tensile strength	MPa	4691.742	Strain: 0.03%
12	S_{1C}	Longitudinal Compressive strength	MPa	-5251.95	Strain: 0.03%
13	S_{2T}	Transverse Tensile strength	MPa	2995.63	Strain: 0.03%
14	S_{2C}	Transverse compressive strength	MPa	-313.1795	Strain: 0.03%
15	S_{3T}	Tensile strength	MPa	310.4562	Strain: 0.03%
16	S_{3C}	Compressive strength	MPa	-403.0484	Strain: 0.03%
17	S_{12}	Out-of-plane shear strength	MPa	154.4688	-
18	S_{23}	Shear strength	MPa	154.4688	-
19	k	Thermal conductivity	W/m·K	431.3555	
20	C_p	Specific heat	kJ/kg·K	493.44	

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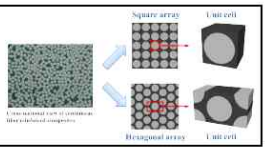


■ Material properties

☐ Weave

Brand	SK Chemical
Pattern	Woven
Fiber material	Carbon
Lay up type	Multi layer

☐ Material properties

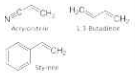
Property	Unit	Value
E-Modulus	GPa	113
Poisson's ratio	-	0.3
Density	g/mm³	1.84

☐ Resin

Type	PET

☐ Material properties

Property	Unit	Value
E-Modulus	MPa	552
Poisson's ratio	-	0.25
Density	g/mm³	1.61



■ Property according to direction(XYZ)

No.	Symbol	Properties	Unit	Value	Notes
1	ρ	Density	g/mm³	1.701E-09	-
2	E_1	Young's Modulus X	MPa	121378.4	Longitudinal modulus
3	E_2	Young's Modulus Y	MPa	10893.12	Transverse Modulus
4	E_3	Young's Modulus Z	MPa	9894.584	-
5	ν_{12}	Poisson's ratio XY	MPa	0.589725	-
6	ν_{13}	Poisson's ratio YZ	MPa	0.479643	-
7	ν_{23}	Poisson's ratio XZ	MPa	0.3361854	-
8	G_{12}	Shear Modulus XY	MPa	3551.111	In-plane shear modulus
9	G_{13}	Shear Modulus YZ	MPa	4137.533	Out-of-plane shear modulus
10	G_{23}	Shear Modulus XZ	MPa	3899.477	Out-of-plane shear modulus
11	S_{1T}	Longitudinal Tensile strength	MPa	4761.768	Strain: 0.03%
12	S_{1C}	Longitudinal Compressive strength	MPa	-3711.378	Strain: 0.03%
13	S_{2T}	Transverse Tensile strength	MPa	3540.29	Strain: 0.03%
14	S_{2C}	Transverse compressive strength	MPa	-318.6261	Strain: 0.03%
15	S_{3T}	Tensile strength	MPa	277.7766	Strain: 0.03%
16	S_{3C}	Compressive strength	MPa	-285.9465	Strain: 0.03%
17	S_{12}	Out-of-plane shear strength	MPa	153.333	-
18	S_{23}	Shear strength	MPa	138.5676	-
19	k	Thermal conductivity	W/m·K	434.752	
20	C_p	Specific heat	kJ/kg·K	474.165	

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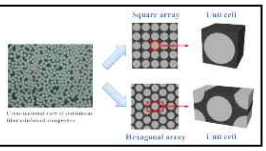


■ Material properties

☐ Weave

Brand	SK Chemical
Pattern	Woven
Fiber material	Carbon
Lay up type	Multi layer

☐ Material properties

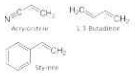
Property	Unit	Value
E-Modulus	GPa	108
Poisson's ratio	-	0.25
Density	g/mm³	1.85

☐ Resin

Type	PET

☐ Material properties

Property	Unit	Value
E-Modulus	MPa	412
Poisson's ratio	-	0.25
Density	g/mm³	1.72



■ Property according to direction(XYZ)

No.	Symbol	Properties	Unit	Value	Notes
1	ρ	Density	g/mm³	1.644E-09	-
2	E_1	Young's Modulus X	MPa	145887.5	Longitudinal modulus
3	E_2	Young's Modulus Y	MPa	9985.36	Transverse Modulus
4	E_3	Young's Modulus Z	MPa	9259.152	-
5	ν_{12}	Poisson's ratio XY	MPa	0.581862	-
6	ν_{13}	Poisson's ratio YZ	MPa	0.4835745	-
7	ν_{23}	Poisson's ratio XZ	MPa	0.2466972	-
8	G_{12}	Shear Modulus XY	MPa	3909.48	In-plane shear modulus
9	G_{13}	Shear Modulus YZ	MPa	3453.374	Out-of-plane shear modulus
10	G_{23}	Shear Modulus XZ	MPa	5489.555	Out-of-plane shear modulus
11	S_{1T}	Longitudinal Tensile strength	MPa	5006.859	Strain: 0.03%
12	S_{1C}	Longitudinal Compressive strength	MPa	-5111.898	Strain: 0.03%
13	S_{2T}	Transverse Tensile strength	MPa	3104.562	Strain: 0.03%
14	S_{2C}	Transverse compressive strength	MPa	-321.3494	Strain: 0.03%
15	S_{3T}	Tensile strength	MPa	343.1358	Strain: 0.03%
16	S_{3C}	Compressive strength	MPa	-272.33	Strain: 0.03%
17	S_{12}	Out-of-plane shear strength	MPa	165.8268	-
18	S_{23}	Shear strength	MPa	131.7528	-
19	k	Thermal conductivity	W/m·K	349.8395	
20	C_p	Specific heat	kJ/kg·K	520.425	

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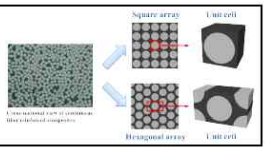


■ Material properties

☐ Weave

Brand	SK Chemical
Pattern	Woven
Fiber material	Carbon
Lay up type	Multi layer

☐ Material properties

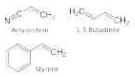
Property	Unit	Value
E-Modulus	GPa	123
Poisson's ratio	-	0.25
Density	g/mm³	1.52

☐ Resin

Type	PET

☐ Material properties

Property	Unit	Value
E-Modulus	MPa	569
Poisson's ratio	-	0.25
Density	g/mm³	1.83



■ Property according to direction(XYZ)

No.	Symbol	Properties	Unit	Value	Notes
1	ρ	Density	g/mm³	2.073E-09	-
2	E_1	Young's Modulus X	MPa	166895.3	Longitudinal modulus
3	E_2	Young's Modulus Y	MPa	12163.984	Transverse Modulus
4	E_3	Young's Modulus Z	MPa	10439.24	-
5	ν_{12}	Poisson's ratio XY	MPa	0.511095	-
6	ν_{13}	Poisson's ratio YZ	MPa	0.542547	-
7	ν_{23}	Poisson's ratio XZ	MPa	0.2999064	-
8	G_{12}	Shear Modulus XY	MPa	4463.323	In-plane shear modulus
9	G_{13}	Shear Modulus YZ	MPa	4300.428	Out-of-plane shear modulus
10	G_{23}	Shear Modulus XZ	MPa	5073.106	Out-of-plane shear modulus
11	S_{1T}	Longitudinal Tensile strength	MPa	3921.456	Strain: 0.03%
12	S_{1C}	Longitudinal Compressive strength	MPa	-4831.794	Strain: 0.03%
13	S_{2T}	Transverse Tensile strength	MPa	3022.863	Strain: 0.03%
14	S_{2C}	Transverse compressive strength	MPa	-299.563	Strain: 0.03%
15	S_{3T}	Tensile strength	MPa	277.7766	Strain: 0.03%
16	S_{3C}	Compressive strength	MPa	-318.6261	Strain: 0.03%
17	S_{12}	Out-of-plane shear strength	MPa	132.8886	-
18	S_{23}	Shear strength	MPa	141.975	-
19	k	Thermal conductivity	W/m·K	400.787	
20	C_p	Specific heat	kJ/kg·K	562.83	

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■ Theory

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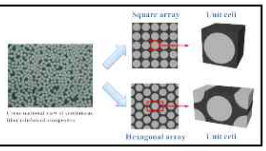


■ Material properties

☐ Weave

Brand	SK Chemical
Pattern	Woven
Fiber material	Carbon
Lay up type	Multi layer

☐ Material properties

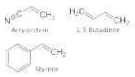
Property	Unit	Value
E-Modulus	GPa	108
Poisson's ratio	-	0.25
Density	g/mm³	1.62

☐ Resin

Type	PET

☐ Material properties

Property	Unit	Value
E-Modulus	MPa	338
Poisson's ratio	-	0.29
Density	g/mm³	1.68



■ Property according to direction(XYZ)

No.	Symbol	Properties	Unit	Value	Notes
1	ρ	Density	g/mm³	1.930E-09	-
2	E_1	Young's Modulus X	MPa	152890.1	Longitudinal modulus
3	E_2	Young's Modulus Y	MPa	11347	Transverse Modulus
4	E_3	Young's Modulus Z	MPa	11347	-
5	ν_{12}	Poisson's ratio XY	MPa	0.4678485	-
6	ν_{13}	Poisson's ratio YZ	MPa	0.4285335	-
7	ν_{23}	Poisson's ratio XZ	MPa	0.253953	-
8	G_{12}	Shear Modulus XY	MPa	3355.637	In-plane shear modulus
9	G_{13}	Shear Modulus YZ	MPa	3290.479	Out-of-plane shear modulus
10	G_{23}	Shear Modulus XZ	MPa	5148.824	Out-of-plane shear modulus
11	S_{1T}	Longitudinal Tensile strength	MPa	4271.586	Strain: 0.03%
12	S_{1C}	Longitudinal Compressive strength	MPa	-3501.3	Strain: 0.03%
13	S_{2T}	Transverse Tensile strength	MPa	2995.63	Strain: 0.03%
14	S_{2C}	Transverse compressive strength	MPa	-403.0484	Strain: 0.03%
15	S_{3T}	Tensile strength	MPa	294.1164	Strain: 0.03%
16	S_{3C}	Compressive strength	MPa	-299.563	Strain: 0.03%
17	S_{12}	Out-of-plane shear strength	MPa	144.2466	-
18	S_{23}	Shear strength	MPa	164.691	-
19	k	Thermal conductivity	W/m·K	431.3555	
20	C_p	Specific heat	kJ/kg·K	424.05	

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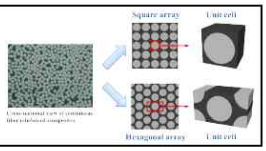


■ Material properties

☐ Weave

Brand	SK Chemical
Pattern	Woven
Fiber material	Carbon
Lay up type	Multi layer

☐ Material properties

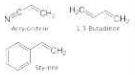
Property	Unit	Value
E-Modulus	GPa	118
Poisson's ratio	-	0.26
Density	g/mm³	1.7

☐ Resin

Type	PET

☐ Material properties

Property	Unit	Value
E-Modulus	MPa	502
Poisson's ratio	-	0.29
Density	g/mm³	1.63



■ Property according to direction(XYZ)

No.	Symbol	Properties	Unit	Value	Notes
1	ρ	Density	g/mm³	1.973E-09	-
2	E_1	Young's Modulus X	MPa	154057.2	Longitudinal modulus
3	E_2	Young's Modulus Y	MPa	11528.552	Transverse Modulus
4	E_3	Young's Modulus Z	MPa	11074.672	-
5	ν_{12}	Poisson's ratio XY	MPa	0.573999	-
6	ν_{13}	Poisson's ratio YZ	MPa	0.4206705	-
7	ν_{23}	Poisson's ratio XZ	MPa	0.2587902	-
8	G_{12}	Shear Modulus XY	MPa	4658.797	In-plane shear modulus
9	G_{13}	Shear Modulus YZ	MPa	4658.797	Out-of-plane shear modulus
10	G_{23}	Shear Modulus XZ	MPa	4580.939	Out-of-plane shear modulus
11	S_{11T}	Longitudinal Tensile strength	MPa	3956.469	Strain: 0.03%
12	S_{11C}	Longitudinal Compressive strength	MPa	-4166.547	Strain: 0.03%
13	S_{22T}	Transverse Tensile strength	MPa	2804.999	Strain: 0.03%
14	S_{22C}	Transverse compressive strength	MPa	-288.6698	Strain: 0.03%
15	S_{33T}	Tensile strength	MPa	283.2232	Strain: 0.03%
16	S_{33C}	Compressive strength	MPa	-392.1552	Strain: 0.03%
17	S_{12S}	Out-of-plane shear strength	MPa	169.2342	-
18	S_{23S}	Shear strength	MPa	143.1108	-
19	k	Thermal conductivity	W/m·K	499.2855	
20	C_p	Specific heat	kJ/kg·K	435.615	

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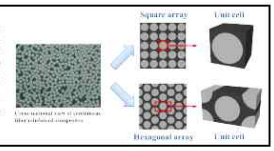


■ Material properties

☐ Weave

Brand	SK Chemical
Pattern	Woven
Fiber material	Carbon
Lay up type	Multi layer

☐ Material properties

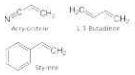
Property	Unit	Value
E-Modulus	GPa	109
Poisson's ratio	-	0.29
Density	g/mm³	1.77

☐ Resin

Type	PET

☐ Material properties

Property	Unit	Value
E-Modulus	MPa	373
Poisson's ratio	-	0.26
Density	g/mm³	1.5



■ Property according to direction(XYZ)

No.	Symbol	Properties	Unit	Value	Notes
1	ρ	Density	g/mm³	1.787E-09	-
2	E_1	Young's Modulus X	MPa	172730.8	Longitudinal modulus
3	E_2	Young's Modulus Y	MPa	11347	Transverse Modulus
4	E_3	Young's Modulus Z	MPa	10983.896	-
5	ν_{12}	Poisson's ratio XY	MPa	0.424602	-
6	ν_{13}	Poisson's ratio YZ	MPa	0.4363965	-
7	ν_{23}	Poisson's ratio XZ	MPa	0.2805576	-
8	G_{12}	Shear Modulus XY	MPa	4495.902	In-plane shear modulus
9	G_{13}	Shear Modulus YZ	MPa	4886.85	Out-of-plane shear modulus
10	G_{23}	Shear Modulus XZ	MPa	4543.08	Out-of-plane shear modulus
11	S_{11T}	Longitudinal Tensile strength	MPa	4306.599	Strain: 0.03%
12	S_{11C}	Longitudinal Compressive strength	MPa	-3746.391	Strain: 0.03%
13	S_{22T}	Transverse Tensile strength	MPa	3458.591	Strain: 0.03%
14	S_{22C}	Transverse compressive strength	MPa	-337.6892	Strain: 0.03%
15	S_{33T}	Tensile strength	MPa	351.3057	Strain: 0.03%
16	S_{33C}	Compressive strength	MPa	-315.9028	Strain: 0.03%
17	S_{12S}	Out-of-plane shear strength	MPa	161.2836	-
18	S_{23S}	Shear strength	MPa	121.5306	-
19	k	Thermal conductivity	W/m·K	353.236	
20	C_p	Specific heat	kJ/kg·K	493.44	