

복합재료(Composite+PA) 물성 DB (200개)

○ 시험 개요

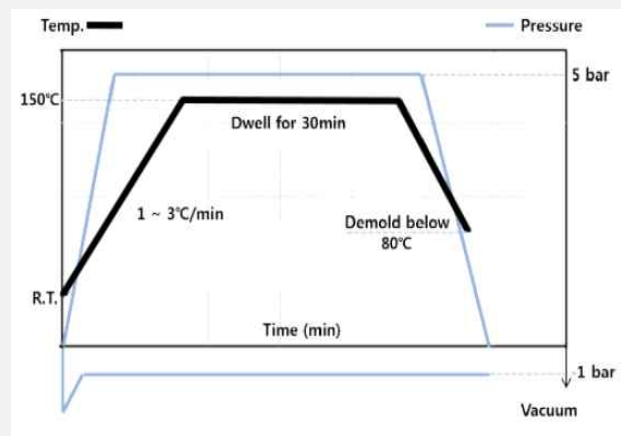
탄소섬유 강화 복합재료에 대한 시뮬레이션 물성 라이브러리를 구축하기 위해, 다양한 복합구조체의 섬유 방향과 적층수와 수지 종류에 따른 재료 물성 차이를 조사하고, 이에 따른 결과를 데이터 베이스(Data Base, DB) 구축하는 것이 목적임.

○ 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.

○ 성형 조건 및 시험 환경

시험환경은 대기온도 25℃, 습도 20%에서 시험.



<성형조건>

○ 시험장비(만능재료시험기)

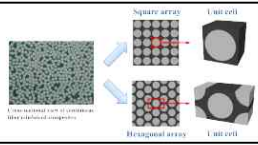


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Data base report of material properties library for polymer composite engineering

Theory

Representative elementary volume (REV) 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

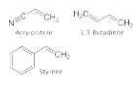
Weave		Material properties		
Brand	SK Chemical	Property	Unit	Value
Pattern	Woven	E-Modulus	GPa	101
Fiber material	Carbon	Poisson's ratio	-	0.27
Lay up type	Multi layer	Density	g/mm ³	1.79



Resin		Material properties		
Type	PA	Property	Unit	Value
		E-Modulus	MPa	594
		Poisson's ratio	-	0.28
		Density	g/mm ³	1.66



Property	Unit	Value
E-Modulus	MPa	594
Poisson's ratio	-	0.28
Density	g/mm ³	1.66



Property according to direction(XYZ)

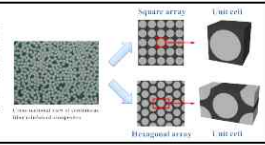
No.	Symbol	Properties	Unit	Value	Notes
1	p	Density	g/mm ³	1.730E-09	-
2	E ₁	Young's Modulus X	MPa	162226.9	Longitudinal modulus
3	E ₂	Young's Modulus Y	MPa	12163.984	Transverse Modulus
4	E ₃	Young's Modulus Z	MPa	12254.76	-
5	ν ₁₂	Poisson's ratio XY	MPa	0.4285335	-
6	ν ₁₃	Poisson's ratio YZ	MPa	0.495369	-
7	ν ₂₃	Poisson's ratio XZ	MPa	0.350697	-
8	G ₁₂	Shear Modulus XY	MPa	4821.692	In-plane shear modulus
9	G ₁₃	Shear Modulus YZ	MPa	4365.586	Out-of-plane shear modulus
10	G ₂₃	Shear Modulus XZ	MPa	4618.798	Out-of-plane shear modulus
11	S _{11T}	Longitudinal Tensile strength	MPa	3991.482	Strain: 0.03%
12	S _{11C}	Longitudinal Compressive strength	MPa	-5111.898	Strain: 0.03%
13	S _{22T}	Transverse Tensile strength	MPa	3213.494	Strain: 0.03%
14	S _{22C}	Transverse compressive strength	MPa	-275.053	Strain: 0.03%
15	S _{33T}	Tensile strength	MPa	296.8397	Strain: 0.03%
16	S _{33C}	Compressive strength	MPa	-296.8397	Strain: 0.03%
17	S _{12T}	Out-of-plane shear strength	MPa	136.296	-
18	S _{12C}	Shear strength	MPa	154.4688	-
19	k	Thermal conductivity	W/mK	455.131	-
20	C _p	Specific heat	kJ/kgK	420.195	-

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Material properties

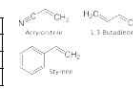
Weave		Material properties		
Brand	SK Chemical	Property	Unit	Value
Pattern	Woven	E-Modulus	GPa	128
Fiber material	Carbon	Poisson's ratio	-	0.29
Lay up type	Multi layer	Density	g/mm ³	1.75



Resin		Material properties		
Type	PA	Property	Unit	Value
		E-Modulus	MPa	550
		Poisson's ratio	-	0.27
		Density	g/mm ³	1.75



Property	Unit	Value
E-Modulus	MPa	550
Poisson's ratio	-	0.27
Density	g/mm ³	1.75



Property according to direction(XYZ)

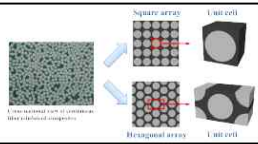
No.	Symbol	Properties	Unit	Value	Notes
1	p	Density	g/mm ³	1.844E-09	-
2	E ₁	Young's Modulus X	MPa	162226.9	Longitudinal modulus
3	E ₂	Young's Modulus Y	MPa	10530.016	Transverse Modulus
4	E ₃	Young's Modulus Z	MPa	13434.848	-
5	ν ₁₂	Poisson's ratio XY	MPa	0.3970815	-
6	ν ₁₃	Poisson's ratio YZ	MPa	0.5228995	-
7	ν ₂₃	Poisson's ratio XZ	MPa	0.355342	-
8	G ₁₂	Shear Modulus XY	MPa	4593.639	In-plane shear modulus
9	G ₁₃	Shear Modulus YZ	MPa	4430.744	Out-of-plane shear modulus
10	G ₂₃	Shear Modulus XZ	MPa	3785.9	Out-of-plane shear modulus
11	S _{11T}	Longitudinal Tensile strength	MPa	4236.573	Strain: 0.03%
12	S _{11C}	Longitudinal Compressive strength	MPa	-4726.755	Strain: 0.03%
13	S _{22T}	Transverse Tensile strength	MPa	3649.222	Strain: 0.03%
14	S _{22C}	Transverse compressive strength	MPa	-405.7717	Strain: 0.03%
15	S _{33T}	Tensile strength	MPa	334.9659	Strain: 0.03%
16	S _{33C}	Compressive strength	MPa	-334.9659	Strain: 0.03%
17	S _{12T}	Out-of-plane shear strength	MPa	148.7898	-
18	S _{12C}	Shear strength	MPa	157.8762	-
19	k	Thermal conductivity	W/mK	441.545	-
20	C _p	Specific heat	kJ/kgK	435.615	-

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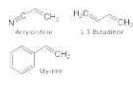
Weave		Material properties		
Brand	SK Chemical	Property	Unit	Value
Pattern	Woven	E-Modulus	GPa	113
Fiber material	Carbon	Poisson's ratio	-	0.29
Lay up type	Multi layer	Density	g/mm ³	1.51



Resin		Material properties		
Type	PA	Property	Unit	Value
		E-Modulus	MPa	571
		Poisson's ratio	-	0.3
		Density	g/mm ³	1.65



Property	Unit	Value
E-Modulus	MPa	571
Poisson's ratio	-	0.3
Density	g/mm ³	1.65



Property according to direction(XYZ)

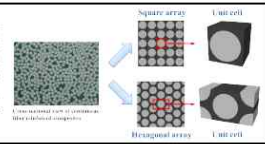
No.	Symbol	Properties	Unit	Value	Notes
1	p	Density	g/mm ³	2.087E-09	-
2	E ₁	Young's Modulus X	MPa	169229.5	Longitudinal modulus
3	E ₂	Young's Modulus Y	MPa	10257.688	Transverse Modulus
4	E ₃	Young's Modulus Z	MPa	11800.88	-
5	ν ₁₂	Poisson's ratio XY	MPa	0.4757115	-
6	ν ₁₃	Poisson's ratio YZ	MPa	0.434602	-
7	ν ₂₃	Poisson's ratio XZ	MPa	0.253953	-
8	G ₁₂	Shear Modulus XY	MPa	4886.85	In-plane shear modulus
9	G ₁₃	Shear Modulus YZ	MPa	4398.165	Out-of-plane shear modulus
10	G ₂₃	Shear Modulus XZ	MPa	4770.234	Out-of-plane shear modulus
11	S _{11T}	Longitudinal Tensile strength	MPa	4306.599	Strain: 0.03%
12	S _{11C}	Longitudinal Compressive strength	MPa	-3816.417	Strain: 0.03%
13	S _{22T}	Transverse Tensile strength	MPa	2968.397	Strain: 0.03%
14	S _{22C}	Transverse compressive strength	MPa	-302.2863	Strain: 0.03%
15	S _{33T}	Tensile strength	MPa	291.3931	Strain: 0.03%
16	S _{33C}	Compressive strength	MPa	-321.3494	Strain: 0.03%
17	S _{12T}	Out-of-plane shear strength	MPa	162.4194	-
18	S _{12C}	Shear strength	MPa	139.7034	-
19	k	Thermal conductivity	W/mK	441.545	-
20	C _p	Specific heat	kJ/kgK	393.21	-

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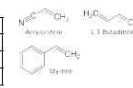
Weave		Material properties		
Brand	SK Chemical	Property	Unit	Value
Pattern	Woven	E-Modulus	GPa	119
Fiber material	Carbon	Poisson's ratio	-	0.25
Lay up type	Multi layer	Density	g/mm ³	1.71



Resin		Material properties		
Type	PA	Property	Unit	Value
		E-Modulus	MPa	560
		Poisson's ratio	-	0.27
		Density	g/mm ³	1.87



Property	Unit	Value
E-Modulus	MPa	560
Poisson's ratio	-	0.27
Density	g/mm ³	1.87



Property according to direction(XYZ)

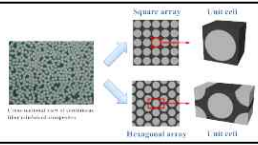
No.	Symbol	Properties	Unit	Value	Notes
1	p	Density	g/mm ³	1.558E-09	-
2	E ₁	Young's Modulus X	MPa	161059.8	Longitudinal modulus
3	E ₂	Young's Modulus Y	MPa	10076.136	Transverse Modulus
4	E ₃	Young's Modulus Z	MPa	12416.313	-
5	ν ₁₂	Poisson's ratio XY	MPa	0.456054	-
6	ν ₁₃	Poisson's ratio YZ	MPa	0.5543415	-
7	ν ₂₃	Poisson's ratio XZ	MPa	0.2829762	-
8	G ₁₂	Shear Modulus XY	MPa	3485.953	In-plane shear modulus
9	G ₁₃	Shear Modulus YZ	MPa	4007.217	Out-of-plane shear modulus
10	G ₂₃	Shear Modulus XZ	MPa	3975.195	Out-of-plane shear modulus
11	S _{11T}	Longitudinal Tensile strength	MPa	4866.807	Strain: 0.03%
12	S _{11C}	Longitudinal Compressive strength	MPa	-4411.638	Strain: 0.03%
13	S _{22T}	Transverse Tensile strength	MPa	3730.921	Strain: 0.03%
14	S _{22C}	Transverse compressive strength	MPa	-291.3931	Strain: 0.03%
15	S _{33T}	Tensile strength	MPa	315.9028	Strain: 0.03%
16	S _{33C}	Compressive strength	MPa	-307.7329	Strain: 0.03%
17	S _{12T}	Out-of-plane shear strength	MPa	127.2096	-
18	S _{12C}	Shear strength	MPa	166.9626	-
19	k	Thermal conductivity	W/mK	363.4255	-
20	C _p	Specific heat	kJ/kgK	424.05	-

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Theory

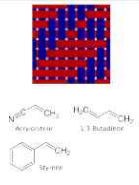
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Material properties

Weave		Material properties	
Brand	SK Chemical	Property	Unit Value
Pattern	Woven	E-Modulus	GPa 125
Fiber material	Carbon	Poisson's ratio	- 0.3
Lay up type	Multi layer	Density	g/mm ³ 1.62

Resin		Material properties	
Type	PA	Property	Unit Value
		E-Modulus	MPa 418
		Poisson's ratio	- 0.29
		Density	g/mm ³ 1.82



Property according to direction(XYZ)

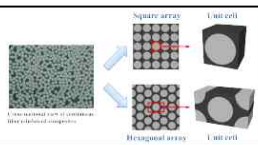
No.	Symbol	Properties	Unit	Value	Notes
1	p	Density	g/mm ³	1.630E-09	-
2	E ₁	Young's Modulus X	MPa	155224.3	Longitudinal modulus
3	E ₂	Young's Modulus Y	MPa	10983.896	Transverse Modulus
4	E ₃	Young's Modulus Z	MPa	12799.416	-
5	ν ₁₂	Poisson's ratio XY	MPa	0.4993005	-
6	ν ₁₃	Poisson's ratio YZ	MPa	0.448191	-
7	ν ₂₃	Poisson's ratio XZ	MPa	0.3531156	-
8	G ₁₂	Shear Modulus XY	MPa	4170.112	In-plane shear modulus
9	G ₁₃	Shear Modulus YZ	MPa	4821.692	Out-of-plane shear modulus
10	G ₂₃	Shear Modulus XZ	MPa	5224.542	Out-of-plane shear modulus
11	S _{11T}	Longitudinal Tensile strength	MPa	5181.924	Strain: 0.03%
12	S _{11C}	Longitudinal Compressive strength	MPa	-4516.677	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	321.3494	Strain: 0.03%
16	S _{33C}	Compressive strength	MPa	-310.4562	Strain: 0.03%
17	S _{12T}	Out-of-plane shear strength	MPa	114.7158	-
18	S _{12C}	Shear strength	MPa	129.4812	-
19	k	Thermal conductivity	W/m·K	478.9065	-
20	C _p	Specific heat	kJ/kg·K	497.295	-

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Theory

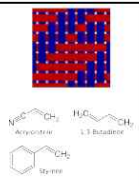
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Material properties

Weave		Material properties	
Brand	SK Chemical	Property	Unit Value
Pattern	Woven	E-Modulus	GPa 110
Fiber material	Carbon	Poisson's ratio	- 0.27
Lay up type	Multi layer	Density	g/mm ³ 1.78

Resin		Material properties	
Type	PA	Property	Unit Value
		E-Modulus	MPa 567
		Poisson's ratio	- 0.28
		Density	g/mm ³ 1.82



Property according to direction(XYZ)

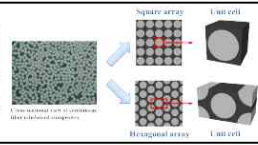
No.	Symbol	Properties	Unit	Value	Notes
1	p	Density	g/mm ³	2.116E-09	-
2	E ₁	Young's Modulus X	MPa	158725.6	Longitudinal modulus
3	E ₂	Young's Modulus Y	MPa	10550.016	Transverse Modulus
4	E ₃	Young's Modulus Z	MPa	10166.912	-
5	ν ₁₂	Poisson's ratio XY	MPa	0.463917	-
6	ν ₁₃	Poisson's ratio YZ	MPa	0.4914375	-
7	ν ₂₃	Poisson's ratio XZ	MPa	0.2515344	-
8	G ₁₂	Shear Modulus XY	MPa	4170.112	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	5224.542	Out-of-plane shear modulus
11	S _{11T}	Longitudinal Tensile strength	MPa	4551.69	Strain: 0.03%
12	S _{11C}	Longitudinal Compressive strength	MPa	-4096.521	Strain: 0.03%
13	S _{22T}	Transverse Tensile strength	MPa	3921.552	Strain: 0.03%
14	S _{22C}	Transverse compressive strength	MPa	-334.9659	Strain: 0.03%
15	S _{33T}	Tensile strength	MPa	305.0096	Strain: 0.03%
16	S _{33C}	Compressive strength	MPa	-340.4125	Strain: 0.03%
17	S _{12T}	Out-of-plane shear strength	MPa	124.938	-
18	S _{12C}	Shear strength	MPa	163.5552	-
19	k	Thermal conductivity	W/m·K	414.373	-
20	C _p	Specific heat	kJ/kg·K	566.685	-

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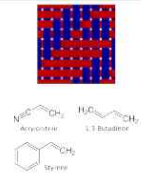
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Weave		Material properties	
Brand	SK Chemical	Property	Unit Value
Pattern	Woven	E-Modulus	GPa 117
Fiber material	Carbon	Poisson's ratio	- 0.28
Lay up type	Multi layer	Density	g/mm ³ 1.8

Resin		Material properties	
Type	PA	Property	Unit Value
		E-Modulus	MPa 374
		Poisson's ratio	- 0.29
		Density	g/mm ³ 1.88



Property according to direction(XYZ)

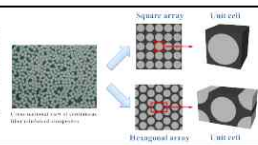
No.	Symbol	Properties	Unit	Value	Notes
1	p	Density	g/mm ³	2.087E-09	-
2	E ₁	Young's Modulus X	MPa	120211.3	Longitudinal modulus
3	E ₂	Young's Modulus Y	MPa	13253.296	Transverse Modulus
4	E ₃	Young's Modulus Z	MPa	12617.864	-
5	ν ₁₂	Poisson's ratio XY	MPa	0.5543415	-
6	ν ₁₃	Poisson's ratio YZ	MPa	0.581862	-
7	ν ₂₃	Poisson's ratio XZ	MPa	0.3434412	-
8	G ₁₂	Shear Modulus XY	MPa	4854.271	In-plane shear modulus
9	G ₁₃	Shear Modulus YZ	MPa	3746.585	Out-of-plane shear modulus
10	G ₂₃	Shear Modulus XZ	MPa	4694.516	Out-of-plane shear modulus
11	S _{11T}	Longitudinal Tensile strength	MPa	4866.807	Strain: 0.03%
12	S _{11C}	Longitudinal Compressive strength	MPa	-4341.612	Strain: 0.03%
13	S _{22T}	Transverse Tensile strength	MPa	3295.193	Strain: 0.03%
14	S _{22C}	Transverse compressive strength	MPa	-370.3688	Strain: 0.03%
15	S _{33T}	Tensile strength	MPa	302.2863	Strain: 0.03%
16	S _{33C}	Compressive strength	MPa	-332.2426	Strain: 0.03%
17	S _{12T}	Out-of-plane shear strength	MPa	165.8268	-
18	S _{12C}	Shear strength	MPa	128.3454	-
19	k	Thermal conductivity	W/m·K	353.236	-
20	C _p	Specific heat	kJ/kg·K	497.295	-

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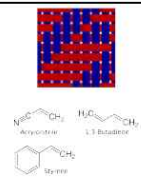
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Weave		Material properties	
Brand	SK Chemical	Property	Unit Value
Pattern	Woven	E-Modulus	GPa 107
Fiber material	Carbon	Poisson's ratio	- 0.28
Lay up type	Multi layer	Density	g/mm ³ 1.82

Resin		Material properties	
Type	PA	Property	Unit Value
		E-Modulus	MPa 453
		Poisson's ratio	- 0.28
		Density	g/mm ³ 1.68



Property according to direction(XYZ)

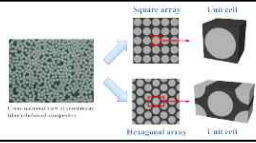
No.	Symbol	Properties	Unit	Value	Notes
1	p	Density	g/mm ³	2.002E-09	-
2	E ₁	Young's Modulus X	MPa	156391.4	Longitudinal modulus
3	E ₂	Young's Modulus Y	MPa	12345.536	Transverse Modulus
4	E ₃	Young's Modulus Z	MPa	11074.672	-
5	ν ₁₂	Poisson's ratio XY	MPa	0.456054	-
6	ν ₁₃	Poisson's ratio YZ	MPa	0.4363965	-
7	ν ₂₃	Poisson's ratio XZ	MPa	0.302325	-
8	G ₁₂	Shear Modulus XY	MPa	3420.795	In-plane shear modulus
9	G ₁₃	Shear Modulus YZ	MPa	3779.164	Out-of-plane shear modulus
10	G ₂₃	Shear Modulus XZ	MPa	3899.477	Out-of-plane shear modulus
11	S _{11T}	Longitudinal Tensile strength	MPa	4446.651	Strain: 0.03%
12	S _{11C}	Longitudinal Compressive strength	MPa	-4446.651	Strain: 0.03%
13	S _{22T}	Transverse Tensile strength	MPa	2995.63	Strain: 0.03%
14	S _{22C}	Transverse compressive strength	MPa	-315.9028	Strain: 0.03%
15	S _{33T}	Tensile strength	MPa	392.1552	Strain: 0.03%
16	S _{33C}	Compressive strength	MPa	-326.796	Strain: 0.03%
17	S _{12T}	Out-of-plane shear strength	MPa	168.0984	-
18	S _{12C}	Shear strength	MPa	129.4812	-
19	k	Thermal conductivity	W/m·K	475.51	-
20	C _p	Specific heat	kJ/kg·K	524.28	-

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Data base report of material properties library for polymer composite engineering

Theory

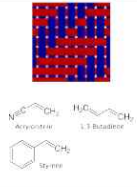
Representative elementary volume (REV) is the smallest volume over which a measurement can be made that will yield a value representative of the whole. In the case of periodic materials, one simply chooses a periodic unit cell (which, however, may be non-unique), but in random media, the situation is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



Material properties

Weave		Material properties	
Brand	SK Chemical	Property	Unit Value
Pattern	Woven	E-Modulus	GPa 127
Fiber material	Carbon	Poisson's ratio	- 0.28
Lay up type	Multi layer	Density	g/mm ³ 1.82

Resin		Material properties	
Type	PA	Property	Unit Value
		E-Modulus	MPa 522
		Poisson's ratio	- 0.26
		Density	g/mm ³ 1.66



Property according to direction(XYZ)

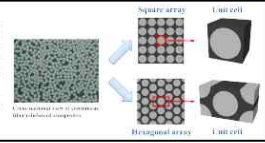
No.	Symbol	Properties	Unit	Value	Notes
1	ρ	Density	g/mm ³	2.130E-09	-
2	E_1	Young's Modulus X	MPa	117877.1	Longitudinal modulus
3	E_2	Young's Modulus Y	MPa	13162.52	Transverse Modulus
4	E_3	Young's Modulus Z	MPa	12980.968	-
5	ν_{12}	Poisson's ratio XY	MPa	0.408876	-
6	ν_{13}	Poisson's ratio YZ	MPa	0.4442595	-
7	ν_{23}	Poisson's ratio XZ	MPa	0.3095808	-
8	G_{12}	Shear Modulus XY	MPa	3746.585	In-plane shear modulus
9	G_{13}	Shear Modulus YZ	MPa	4854.271	Out-of-plane shear modulus
10	G_{23}	Shear Modulus XZ	MPa	4013.054	Out-of-plane shear modulus
11	S_{11T}	Longitudinal Tensile strength	MPa	3816.417	Strain: 0.03%
12	S_{11C}	Longitudinal Compressive strength	MPa	-3676.365	Strain: 0.03%
13	S_{22T}	Transverse Tensile strength	MPa	3022.863	Strain: 0.03%
14	S_{22C}	Transverse compressive strength	MPa	-299.563	Strain: 0.03%
15	S_{33T}	Tensile strength	MPa	383.9853	Strain: 0.03%
16	S_{33C}	Compressive strength	MPa	-356.7523	Strain: 0.03%
17	S_{23}	Out-of-plane shear strength	MPa	115.8516	-
18	S_{18}	Shear strength	MPa	165.8268	-
19	k	Thermal conductivity	W/m.K	489.096	-
20	C_p	Specific heat	kJ/kg.K	400.92	-

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Theory

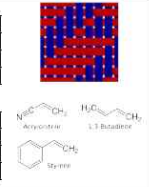
Representative elementary volume (REV) is the smallest volume over which a measurement can be made that will yield a value representative of the whole. In the case of periodic materials, one simply chooses a periodic unit cell (which, however, may be non-unique), but in random media, the situation is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



Material properties

Weave		Material properties	
Brand	SK Chemical	Property	Unit Value
Pattern	Woven	E-Modulus	GPa 114
Fiber material	Carbon	Poisson's ratio	- 0.25
Lay up type	Multi layer	Density	g/mm ³ 1.64

Resin		Material properties	
Type	PA	Property	Unit Value
		E-Modulus	MPa 523
		Poisson's ratio	- 0.28
		Density	g/mm ³ 1.87



Property according to direction(XYZ)

No.	Symbol	Properties	Unit	Value	Notes
1	ρ	Density	g/mm ³	2.059E-09	-
2	E_1	Young's Modulus X	MPa	165728.2	Longitudinal modulus
3	E_2	Young's Modulus Y	MPa	11982.432	Transverse Modulus
4	E_3	Young's Modulus Z	MPa	12436.312	-
5	ν_{12}	Poisson's ratio XY	MPa	0.5228895	-
6	ν_{13}	Poisson's ratio YZ	MPa	0.408876	-
7	ν_{23}	Poisson's ratio XZ	MPa	0.3410226	-
8	G_{12}	Shear Modulus XY	MPa	3290.479	In-plane shear modulus
9	G_{13}	Shear Modulus YZ	MPa	3746.585	Out-of-plane shear modulus
10	G_{23}	Shear Modulus XZ	MPa	4618.798	Out-of-plane shear modulus
11	S_{11T}	Longitudinal Tensile strength	MPa	4166.547	Strain: 0.03%
12	S_{11C}	Longitudinal Compressive strength	MPa	-3676.365	Strain: 0.03%
13	S_{22T}	Transverse Tensile strength	MPa	2723.3	Strain: 0.03%
14	S_{22C}	Transverse compressive strength	MPa	-394.8785	Strain: 0.03%
15	S_{33T}	Tensile strength	MPa	373.0921	Strain: 0.03%
16	S_{33C}	Compressive strength	MPa	-367.6455	Strain: 0.03%
17	S_{23}	Out-of-plane shear strength	MPa	163.5552	-
18	S_{18}	Shear strength	MPa	118.1232	-
19	k	Thermal conductivity	W/m.K	400.787	-
20	C_p	Specific heat	kJ/kg.K	454.89	-