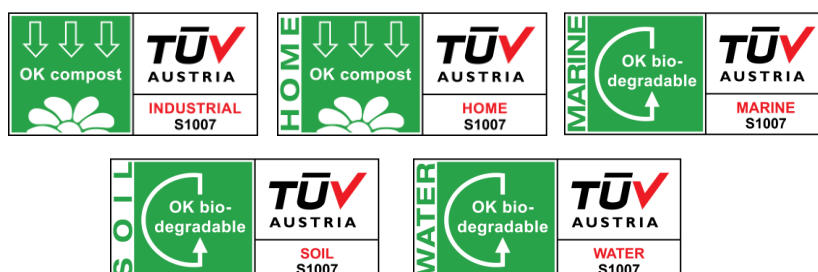


Plasticizer for Polylactic Acid (PLA)

DAIFATTY[®]-101

Technical Data Sheet



ABOUT DAIFATTY®-101

PHYSICAL PROPERTIES

Appearance	Molecular Weight	Specific Gravity	Viscosity (mPa·s)	Refractive Index (nD ₂₅)	Volatility* ¹ (%)
Clear liquid	338	1.109 (20°C)	19 (25°C)	1.494	1.3 (200°C)

*1 200°C Volatility for TG-DTA



CHARACTERISTICS

- ✓ High plasticity with small dosage
- ✓ Non- bleeding
- ✓ High water resistance
- ✓ No influence on transparency of PLA
- ✓ High biodegradation

Our evaluation results show as follows.

We believe all information is accurate. It is offered in good faith, but without guarantee.

Since conditions of use are beyond our control, all risks are assumed by the customer.

Nothing herein shall be construed as a recommendation for uses which infringe valid patents or extending a license under valid patents.

REGULATORY INFORMATION

- ◆ TSCA (USA) : Not Listed.
- ◆ REACH (EU) : Listed. (0-10 tons per annum)
- ◆ ENCS (JAPAN), IECSC (CHINA), ECL (KOREA) : Listed.
- ◆ Biodegradable (JAPAN) : Listed.

Registry number : GreenPla Positive List (B30084)

- ◆ JHOSPA-PL (JAPAN) : Listed.

Registry number : [B]NSM-13216 (for polylactic acid)

BIODEGRADABLE (EU / USA)*

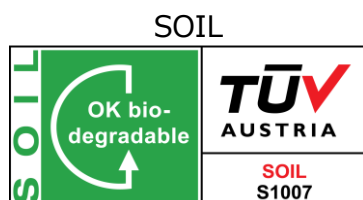
- ▶ OK compost : Listed. (Registry number : S1007)
- ▶ Seedling : Listed. (Registry number : 7Z2007)
- ▶ DIN Geprüft : Listed (Registry number : 8Z0036)
- ▶ BPI : Listed (Registry number : 10529006)

* For only DAIFATTY®-101

【OK compost】



【OK compost】



【Seedling】



【DIN CERTCO】



【BPI】



PERFORMANCE EVALUATION TEST (FILM & SHEET)

TEST METHOD

Polymer	Ingeo™ Biopolymer 3001D, 4032D (Nature Works LLC)	
Formulation	Polymer	100 phr
	Plasticizer	5~20 phr
Mixing	Mixing mill (8 inch)*2	175~180°C×3min.
	Hot press (sheet thickness 0.5mm)	175°C×14.7MPa×3min.→
		→ (Cooling) 4.9MPa×3min.

*2 15.6/12.6 rpm (revolution ratio 1.25:1.00)

CAPABILITY OF DAIFATTY-101

PLA Grade	Additive Amount (phr)	Bleeding*3 (Weight Loss %)	Water Resistance*4 (%)	Tensile Elastic Modulus*5 (MPa)	Tensile Strength*5 (MPa)	Elongation*5 (%)	Glass Transition Temperature*6 (°C)
Ingeo™ 3001D	0	—	—	2320	63	5	58.5
	5	—	—	2160	44	3	50.5
	10	0.08	0.00	2220	31	2	44.4
	15	0.10	0.01	830	14	290	34.5
	20	0.14	0.02	270	3	290	22.7
Ingeo™ 4032D	0	—	—	2230	72	8	58.3
	5	—	—	2070	45	3	50.1
	10	0.13	0.00	2300	38	2	43.7
	15	0.15	0.03	740	14	290	34.3
	20	0.18	0.07	190	4	300	25.6

*3 Heat resistance Test : 30mm×50mm×0.5mm (80°C×24hrs)

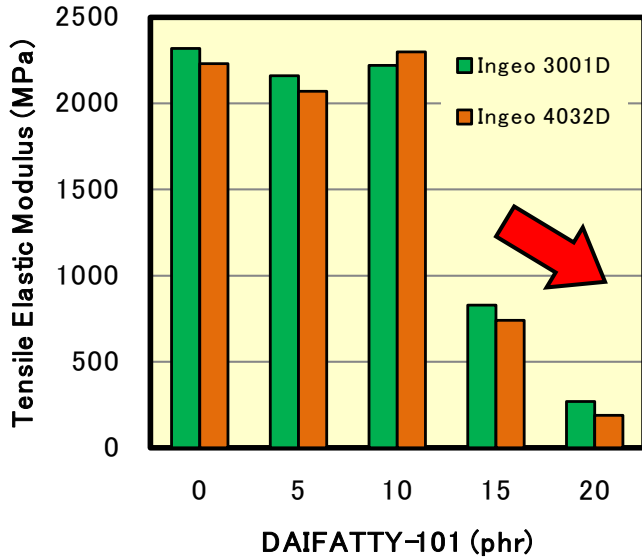
*4 Waterproof Test : 30mm×50mm×0.5mm (25°C×48hrs, in water)

*5 JIS K 7127 (ISO 527-3)

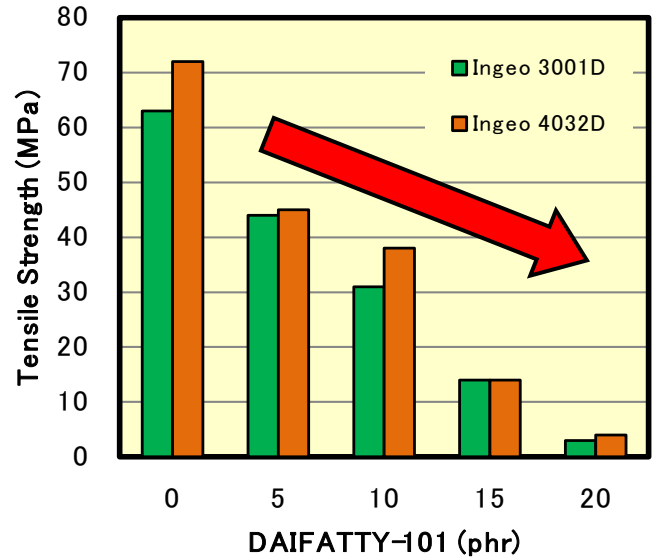
*6 JIS K 7121 (ISO 3146)

PROPERTY EVALUATION TEST FOR FILM & SHEET

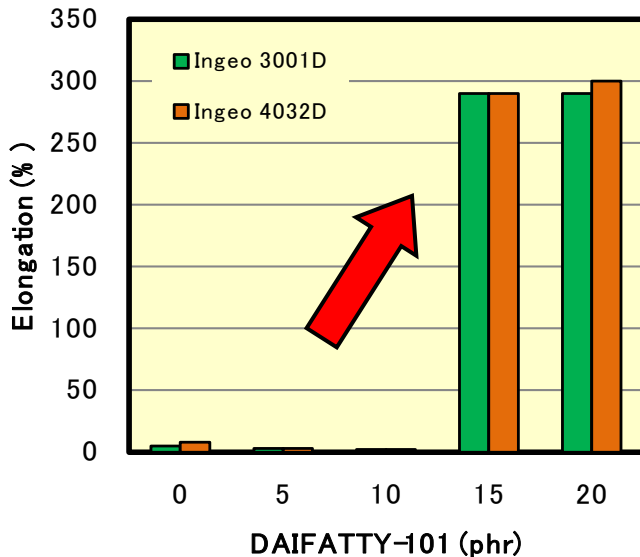
Tensile Elastic Modulus



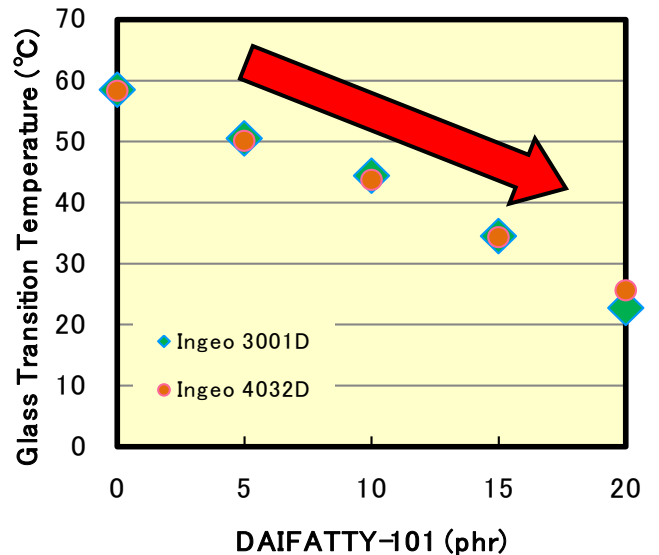
Tensile Strength



Elongation



Glass Transition Temperature



PERFORMANCE EVALUATION TEST (INJECTION)

TEST METHOD

Polymer	Ingeo™ 3001D (Nature Works LLC)	
Formulation	Polymer	90~97 wt%
	Plasticizer	3~10 wt%
Processing Conditions	Mixing	Temp. 160°C, 100~200rpm
	(Twin Extruder)	Feed rate 1.5~2.6kg/hr.
		DF-101 addition rate 1.3~2.8g/min
	Injection Molding	Temp. 160~170, 210°C*7
	Annealing	(1 st) 80°C×24hr. (2 nd) 23°C×50RH%×24hr.

*7 PLA: 210°C, Additive: 160~170°C

CAPABILITY OF DAIFATTY-101

Additive Amount (wt%)	Tensile*8 Elastic Modulus (MPa)	Tensile*8 Strength (MPa)	Elongation*8 (%)	Bending*9 Elastic Modulus (MPa)	Bending*9 Strength (MPa)	Izod*10 Impact Strength (J/m)	HDT*11 (°C)	MFR*12 (g/10min.)
0	2590	74	4	3630	101	32	109	11
3	2710	67	4	3630	101	30	117	14
5	2370	50	23	3020	81	31	112	17
10	1450	34	61	1580	44	60	107	25

*8 ASTM D638

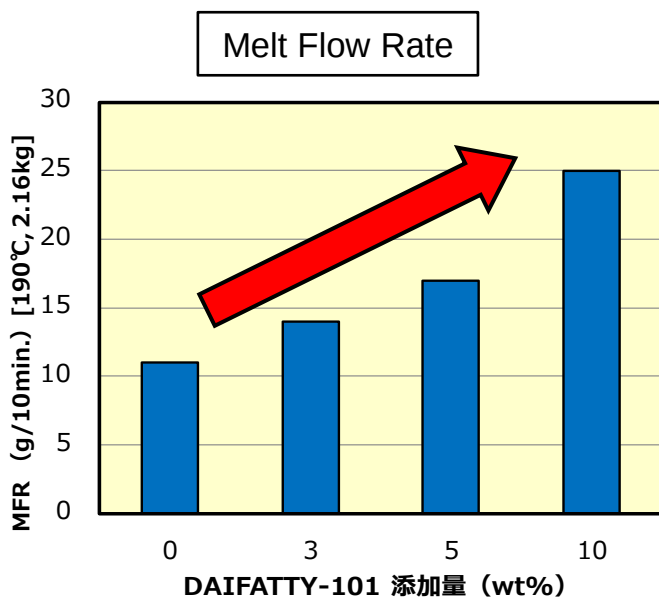
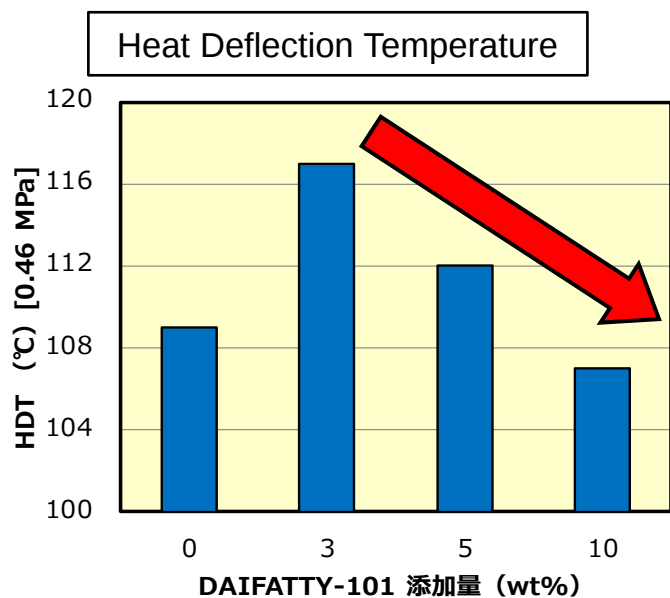
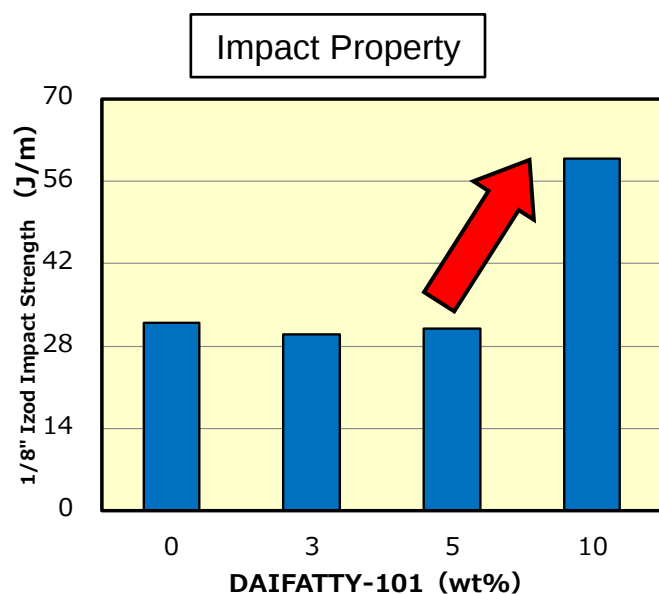
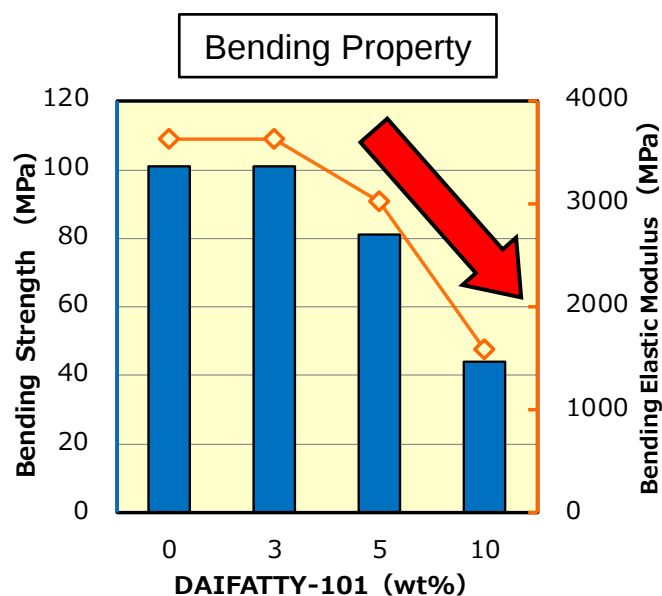
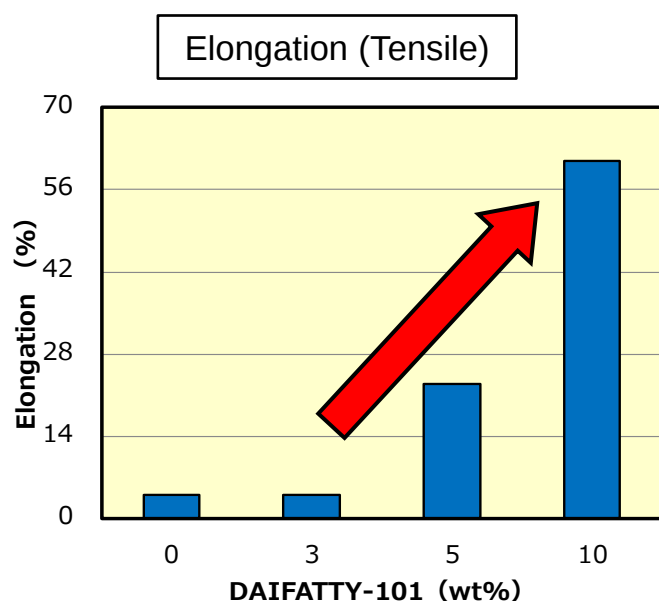
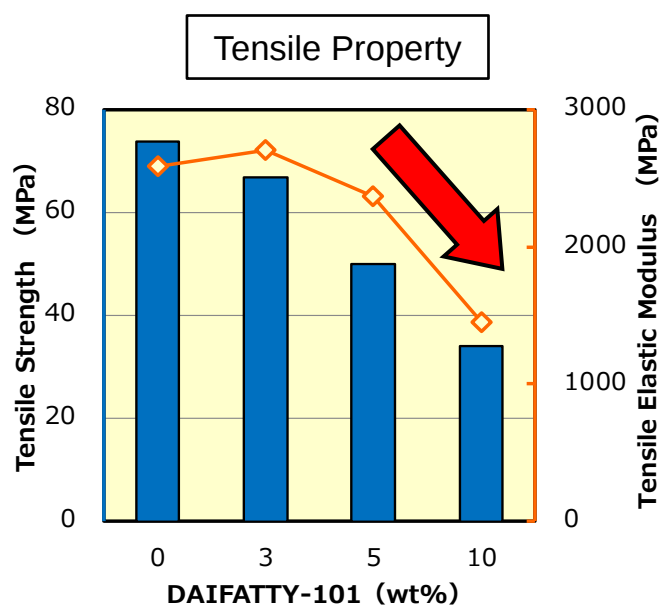
*9 ASTM D790

*10 ASTM D256

*11 ASTM D648

*12 JIS K7210: Temp.190°C, Weight 2.16kg

PROPERTY EVALUATION TEST FOR INJECTION



PLASTICIZATION PERFORMANCE COMPARISON FOR DAIFATTY-101 VS GENERAL PLASTICIZER

■ FOR INGEO™ 3001D

Plasticizer	Bleeding* ³ (Weight Loss %)	Water Resistance* ⁴ (%)	Tensile Elastic Modulus* ⁵ (MPa)	Tensile Strength* ⁵ (MPa)	Elongation* ⁵ (%)	Glass Transition Temperature* ⁶ (°C)
DAIFATTY-101	0.14	0.02	270	3	290	23
ATBC* ¹³	0.43	0.09	1310	32	300	36
GLYCERIN ESTER	1.93	0.08	1410	28	210	39
LACTIC ACID ESTER	1.03	0.21	1750	32	210	37

■ FOR INGEO™ 4032D

Plasticizer	Bleeding* ³ (Weight Loss %)	Water Resistance* ⁴ (%)	Tensile Elastic Modulus* ⁵ (MPa)	Tensile Strength* ⁵ (MPa)	Elongation* ⁵ (%)	Glass Transition Temperature* ⁶ (°C)
DAIFATTY-101	0.18	0.07	190	4	300	26
ATBC* ¹³	0.57	0.05	1520	36	250	36
GLYCERIN ESTER	1.66	0.01	2215	37	5	39
LACTIC ACID ESTER	0.85	1.45	750	17	270	39

*3 Heat resistance Test : 30mm×50mm×0.5mm (80°C×24hrs)

*4 Waterproof Test : 30mm×50mm×0.5mm (25°C×48hrs, in water)

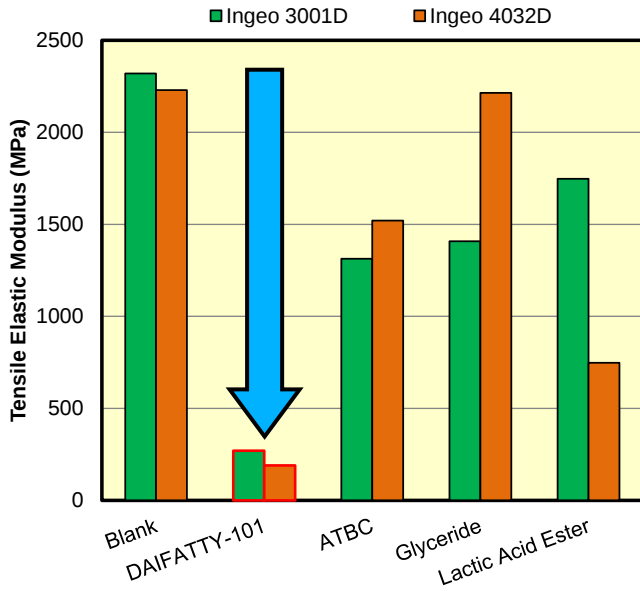
*5 JIS K 7127 (ISO 527-3)

*6 JIS K 7121 (ISO 3146)

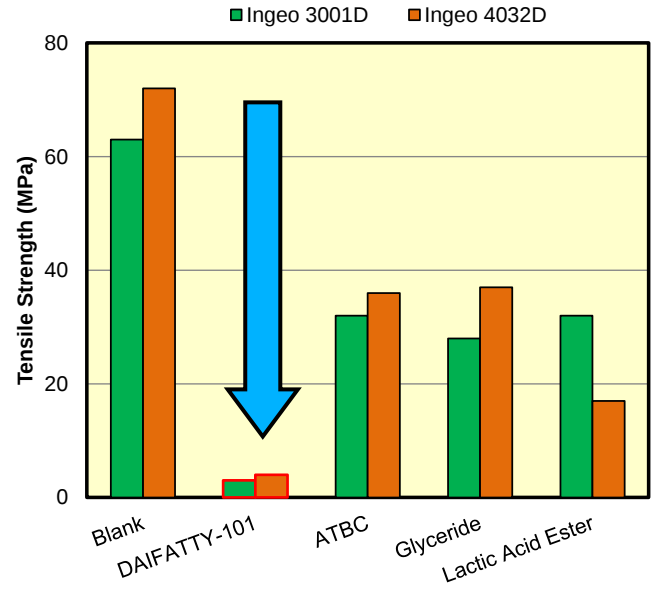
*13 Acetyl tributyl citrate

PLASTICIZATION PERFORMANCE COMPARISON FOR DAIFATTY-101 VS GENERAL PLASTICIZER

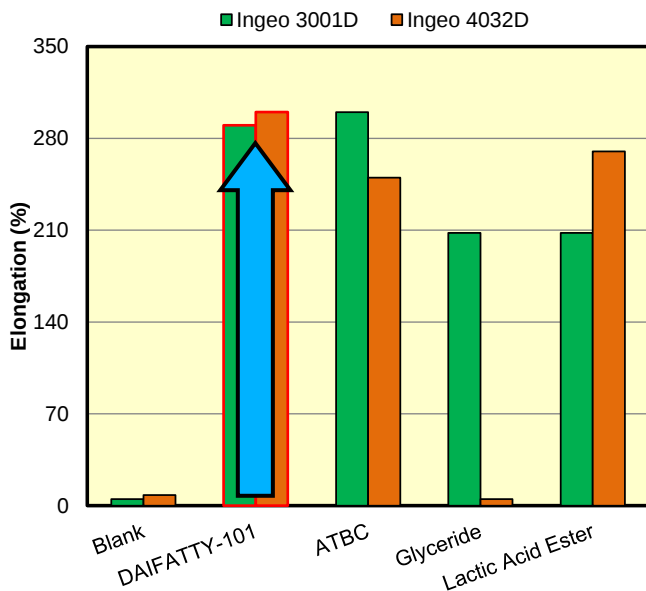
Tensile Elastic Modulus



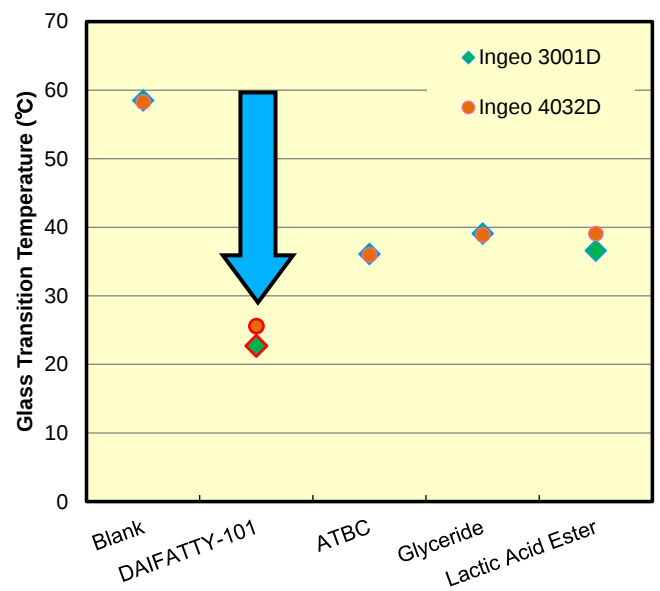
Tensile Strength



Elongation



Glass Transition Temperature



PLASTICIZATION EFFECT OF DAIFATTY-101 FOR BIODEGRADABLE RESIN

TEST METHOD

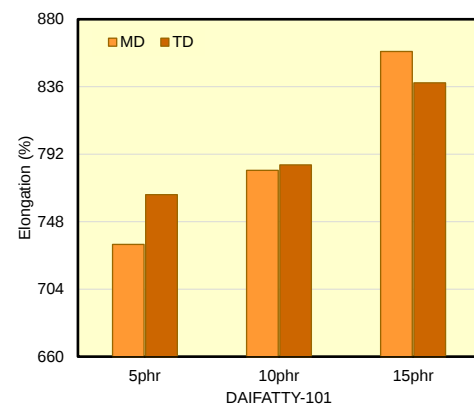
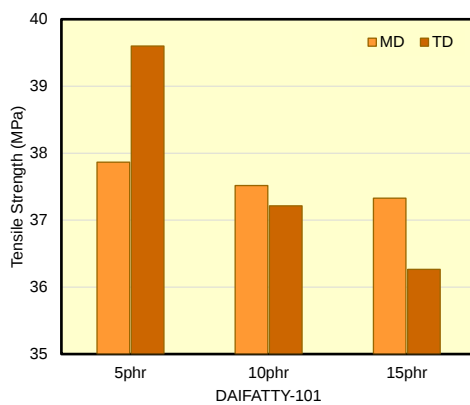
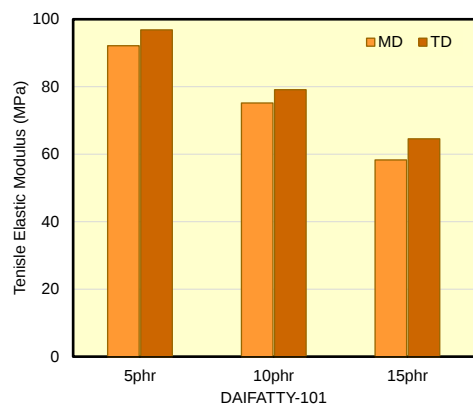
Polymer	PBAT, PBS, Starch resin	
Formulation	Polymer	100 phr
	Plasticizer	5, 10, 15 phr
Mixing	Mixing (Twin Extruder)	Temp. 150~180°C, 200rpm
	Molding (T-die)	Die width 150mm, Lip width 1.0mm
		Temp. 130~200°C

CAPABILITY OF DAIFATTY-101

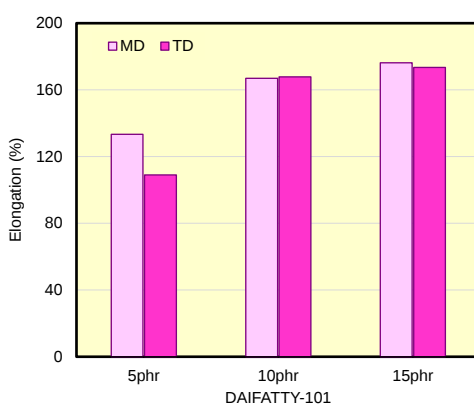
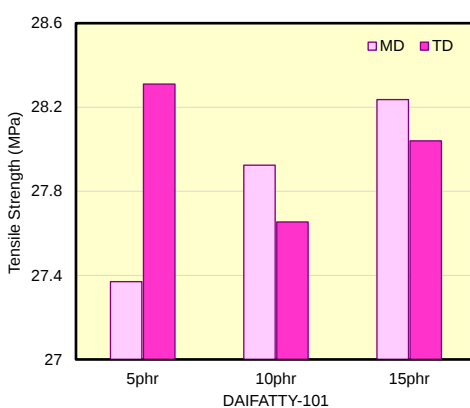
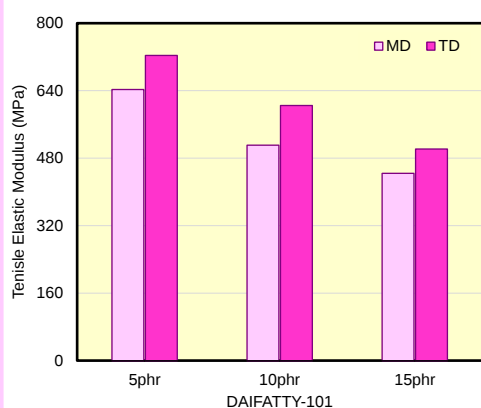
Resin	Additive Amount (phr)	Direction	Tensile Elastic Modulus (MPa)	Tensile Yield Strength (MPa)	Tensile Yield Strain (%)	Tensile Strength (MPa)	Elongation (%)
PBAT	5	MD	92.1	6.7	16.5	37.9	733.2
		TD	96.8	6.8	17.0	39.6	765.6
	10	MD	75.2	6.1	19.7	37.5	781.5
		TD	79.1	6.2	19.7	37.2	785.0
	15	MD	58.3	5.6	22.3	37.3	858.9
		TD	64.6	5.6	22.7	36.3	838.5
PBS	5	MD	642.5	34.7	11.6	27.4	133.3
		TD	723.4	35.1	12.2	28.3	109.0
	10	MD	510.9	30.9	14.0	27.9	166.9
		TD	604.8	31.8	14.0	27.7	167.8
	15	MD	444.0	27.5	14.8	28.2	176.2
		TD	501.7	27.6	15.8	28.0	173.5
Starch resin	5	MD	2817.6	40.7	1.8	23.1	142.2
		TD	2256.6	28.2	1.6	18.7	71.9
	10	MD	1330.0	22.4	2.0	29.2	220.0
		TD	861.0	19.9	2.3	25.3	210.0
	15	MD	98.8	8.9	27.0	27.8	250.0
		TD	70.2	8.7	23.0	24.8	240.0

PLASTICIZATION EFFECT OF DAIFATTY-101 FOR BIODEGRADABLE RESIN

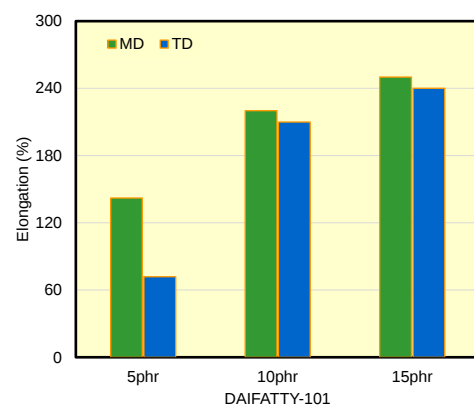
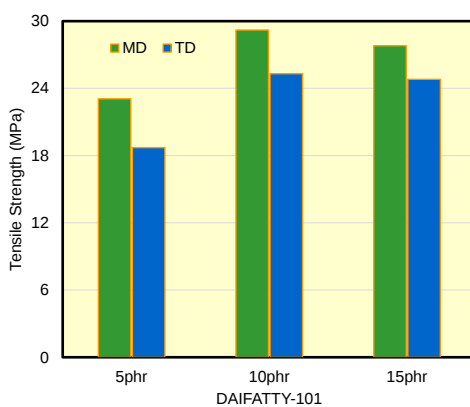
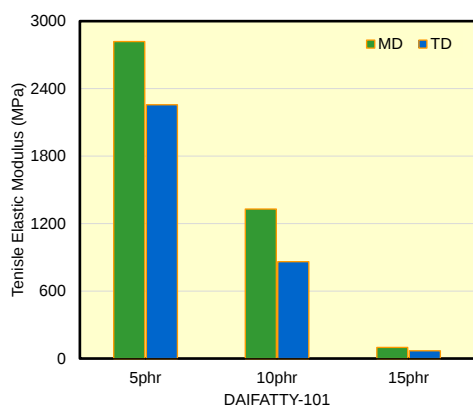
PBAT



PBS



Starch resin





<http://www.daihachi-chem.co.jp/eng/index.html>



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