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Resin Modifiers, Acid Modified Polyolefin

UMEX Products

Preface

UMEX products are a series of acid modified polyolefin.

These products have a higher degree of modification and lower melt viscosity compared with conventional acid modified polyolefin. Therefore the products at low amount of addition improve the dispersibility of pigments, filler and wood flour to the polyolefin resins. And the products improve the adhesion of the polyolefin resins and other materials. Moreover, the products are very effective as a modifier for hot melt adhesives and asphalt.

1. Main Applications of UMEX Products

Table 1 shows main applications of UMEX products.

Table 1. Main Applications of UMEX Products

Improved Performance	UMEX 1001	UMEX 1010	UMEX 5200	UMEX 100TS	UMEX 110TS
Improvement in filler dispersibility in polyolefin	E	E	E	G	G
Improvement in pigment dispersibility in polyolefin	G	G	G	E	E
Improvement in fiberglass adhesion to polyolefin	E	E	E		
Improvement in polyolefin paintability*	G	G	G		
Improvement in polyolefin film printability	G	G	G		
Improvement in fluidity and adhesion of traffic paint for roads	G	G	G	G	G
Improvement in fluidity and adhesion of hot melt adhesives	G	G	G	E	E
Increase in softening point of asphalt	G	G		E	E
Improvement in molding processability of ABS resin and polyamide resin	G	E	G	E	E

Value of symbols E: Excellent G: Good

* Paintability using paint of high polarity such as melamine type and polyurethane type (improvement of adhesion to paint)

2. Product Numbers of the UMEX Products and Features

Figure 1 shows the features of each UMEX product. Select the optimal one according to the use.

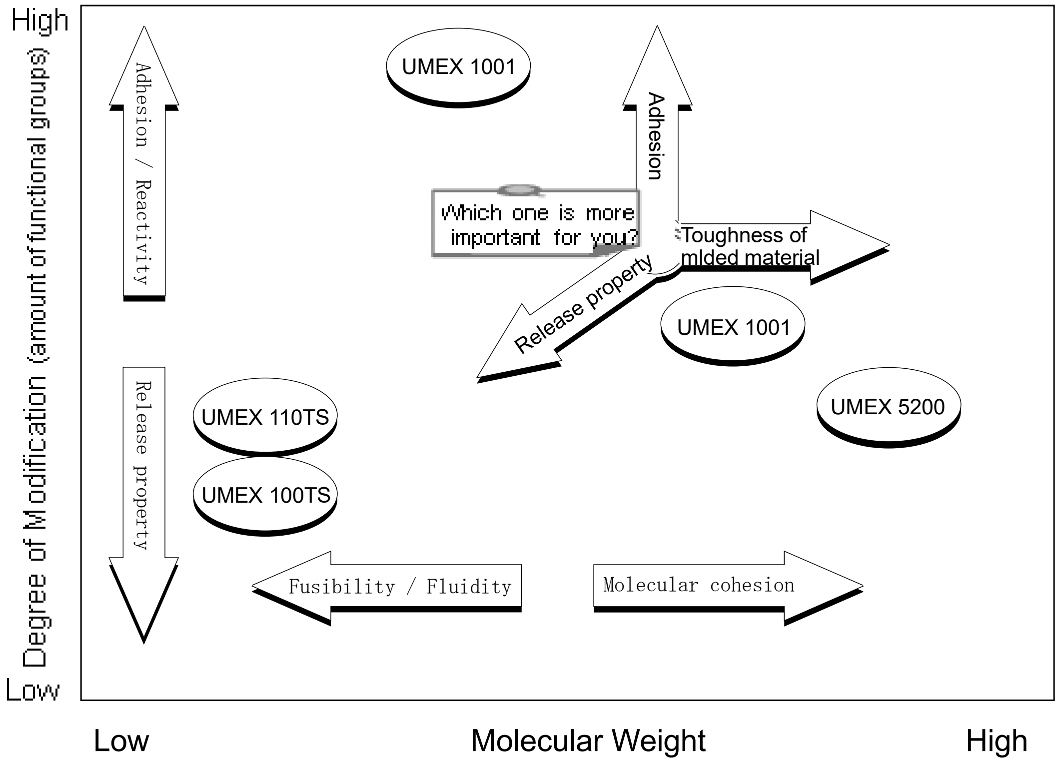

Figure 1. Product Numbers of UMEX Products and Their Features —Conceptual Drawing

3. Applications and the Standard Dosage

For each application, the standard dosage of the UMEX products is shown below.

Resins and Rubber

1) Improvement in Inorganic Filler Dispersibility and Fiberglass Adhesion to Polyolefin

When inorganic fillers such as talc, magnesium hydroxide, etc are added to polyolefin, the following UMEX products help inorganic fillers disperse finely and produce tough molded materials. Also, when fiberglass is added, these products improve the adhesion of fiberglass to the resin, which also produce tough molded materials.

Name of Recommended Product	UMEX 1001, UMEX 1010 and UMEX 5200
Standard Dosage	Between 1 and 5 wt %

2) Improvement of Polyolefin Film Printability

Polar groups of the following UMEX products modify the surface of polyolefin film, thereby the printability of the film is improved.

Name of Recommended Product	UMEX 1001, UMEX 1010 and UMEX 5200
Standard Dosage	Between 2 and 10 wt %

3) Improvement of Resin Molding Processability

The following UMEX products improve the fluidity of melted polyamide resin or melted ABS resin, thereby the molding processability is improved.

Name of Recommended Product	UMEX 1010, UMEX 100TS and UMEX 110TS
Standard Dosage	Between 1 and 5 wt %

4) Improvement of Pigment Dispersibility

When a color masterbatch dispersing pigments with the following UMEX products is used for coloration of molding resins, the pigments disperse more uniformly and the molded materials having excellent glossy surfaces are obtained.

Name of Recommended Product	UMEX 100TS and UMEX 110TS
Standard Dosage	Between 50 and 200 wt % to pigments

Adhesives

1) Increase in Softening Point of Hot Melt Adhesives

The following UMEX products increase the softening point of hot melt adhesives while decreasing the melt viscosity.

Name of Recommended Product	UMEX 100TS and UMEX 110TS
Standard Dosage	Between 2 and 10 wt %

Civil Engineering and Construction

1) Improvement of Asphalt Heat Resistance

The following UMEX products improve asphalt heat resistance by increasing its softening point.

Name of Recommended Product	UMEX 100TS and UMEX 110TS
Standard Dosage	Between 2 and 10 wt %

4. Example Process for Using UMEX Products

A standard example process for using UMEX products is shown below:

Example of Molding Resins and Kneading Temperature

Polypropylene:	Approx. 210 °C	ABS resin:	Approx. 230 °C
Polyamide:	Approx. 240 °C	Polybutylene terephthalate:	Approx. 270 °C

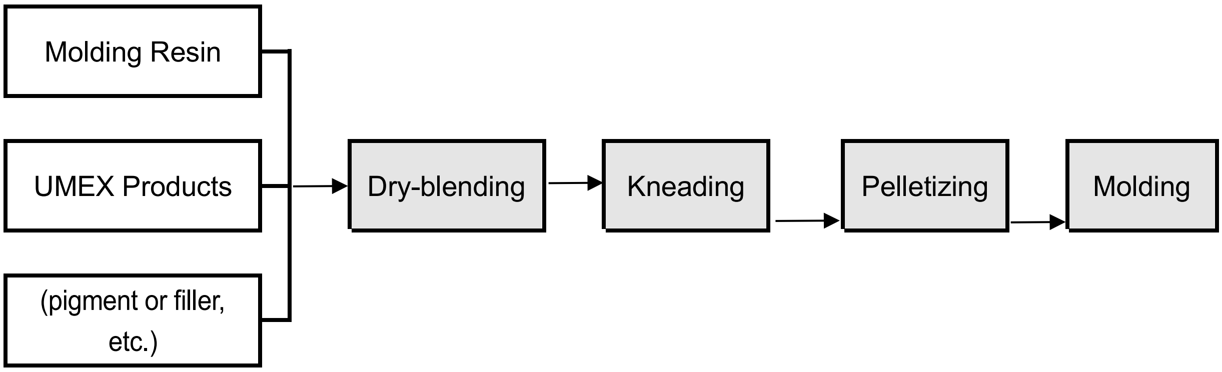

Figure 2. Example Process for Using UMEX Products

Precaution Against Mishandling

· When the UMEX products are excessively added to the resin, these products may have negative effects on resin's physical properties. Test the effects on each of the physical properties beforehand to ensure that there are no problems.

· As shown in Table 2-b on page 7, the compatibility with certain molding resins is insufficient, therefore the transparency may be affected. Before using the UMEX products, confirm the compatibility with resins.

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1. Typical Properties of UMEX Products

Table 2 shows the typical properties and compatibility with other resins.

Table 2-a. Typical Properties

Composition and Property \ Product Name		UMEX 1001	UMEX 1010	UMEX 5200	UMEX 100TS	UMEX 110TS
Composition	Main chain	Polypropylene				
	Functional group	Carboxylic anhydride group				
Appearance		Yellow granule	Yellow granule	Yellow granule	Pale yellow powder	Pale yellow powder
Specific gravity (ASTM D 792)		0.90	0.90	0.90	0.89	0.89
Melt viscosity (160 °C) mPa·s		15,000	6,000	20,000	120	135
Melting Point (DSC Method)		142	135	124	136	138
Acid value (ASTM D 1386)		26	52	11	3.5	7

Table 2-b. Compatibility with Other Resins

Compatibility \ Product Name	UMEX 1001	UMEX 1010	UMEX 5200	UMEX 100TS	UMEX 110TS
Polyethylene	CS	CS	CS	CS	CS
Polypropylene	CS	CS	CS	CS	CS
Ethylene-vinylacetate copolymer	PS	PS	PS	PS	PS
Polyvinyl chloride	IS	IS	IS	IS	IS
Polystyrene	IS	IS	IS	IS	IS
Polyamide	CS	CS	CS	PS	PS
Polycarbonate	PS	PS	PS	IS	IS
Polybutylene terephthalate	PS	PS	PS	PS	PS
Modified PPE	IS	IS	IS	IS	IS
Polymethylmethacrylate	PS	PS	PS	PS	PS
ABS resin	PS	PS	PS	PS	PS

Value of symbols

UMEX Products and other resins were blended at a weight ratio of 5:95 and the melted mixture was measured.

CS: Completely soluble (transparent)
PS: Partially soluble (opaque, no separation into layers)
I S: Incompatible (opaque, separated into the original two layers)

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2. Thermal Stability

Figure 3 and Figure 4 shows thermal stabilities of the UMEX products.

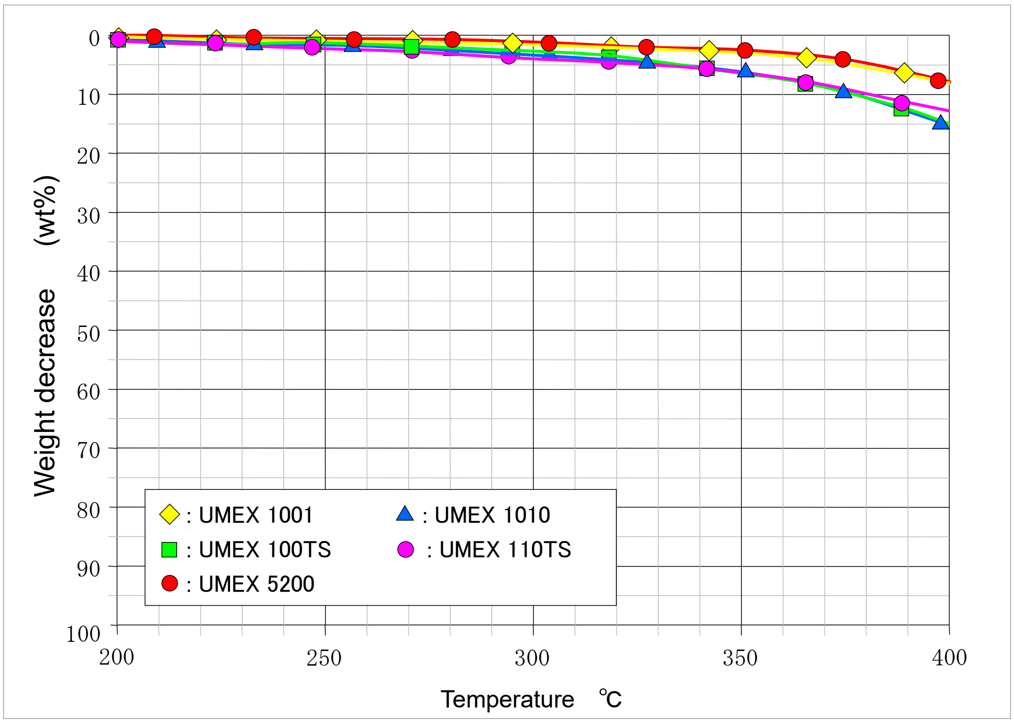

Figure 3. Weight-decreasing Curve in Relation to Temperature Rise (Ambience: Nitrogen)

Method:

Apparatus: Apparatus for thermogravimetry

Heating rate: 10 °C/min Ambience: Nitrogen

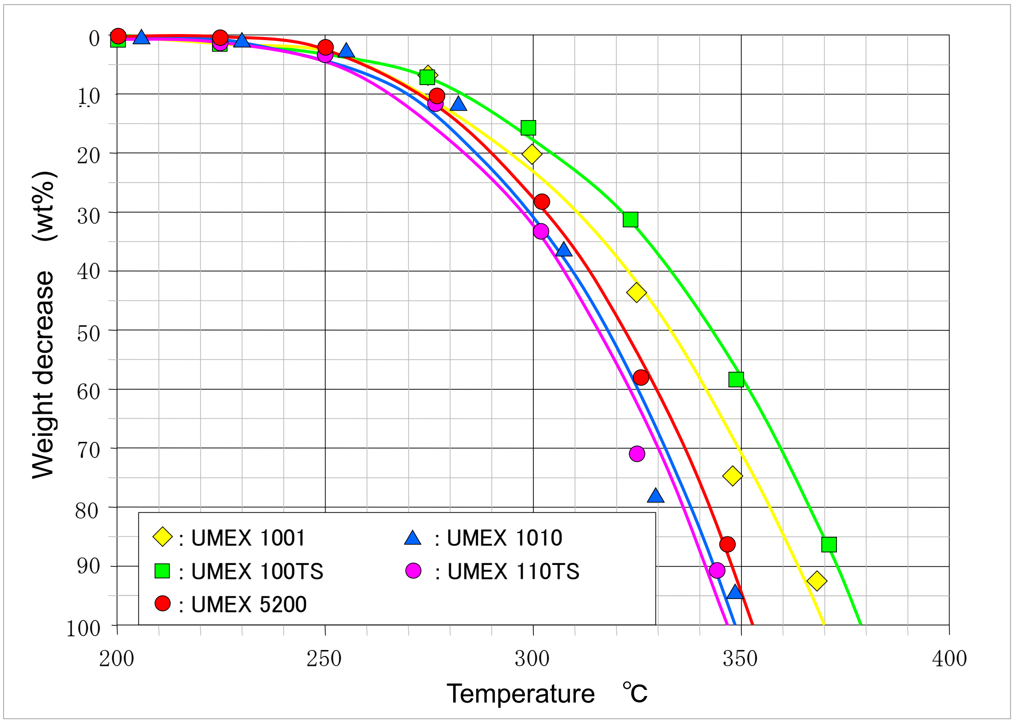

Figure 4. Weight-decreasing Curve in Relation to Temperature Rise (Ambience: Air)

Method:

Apparatus: Apparatus for thermogravimetry

Heating rate: 10 °C/min Ambience: Air

3. Effect on MFR of Polypropylene by adding UMEX products

As shown Figure 5, the MFR of polypropylene is increased by adding UMEX products. Select the polypropylene having the target properties coupled with this effect.

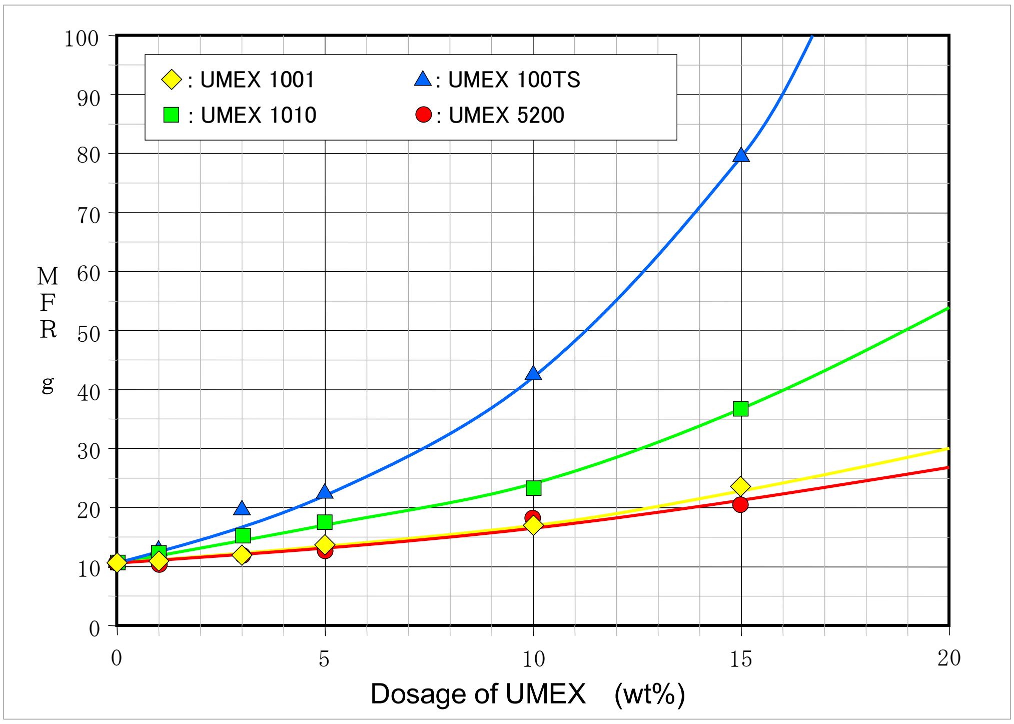

Figure 5. Effect on MFR of Polypropylene by adding UMEX products

Materials and Methods:

Materials:

A predetermined amount of UMEX products was dry-blended with polypropylene [MFR: 11g (230 °C, 21.18 N, 10 min), injection-molding grade], and the mixture was kneaded using a twin-screw extruder at 210 °C.

Methods: MFR of each sample was measured at 230 °C and 21.18 N for 10 min.

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1. Improvement in Dispersibility of Talc in Polypropylene

When either UMEX 1001 or UMEX 1010 is added to a mixture of talc and polypropylene, better molded materials which exhibit a higher tensile stress at yield, a higher flexural strength and a higher flexural modulus are obtained compared with conventional molded materials containing either untreated talc and an acid modified polypropylene or treated talc.

Table 3. Improvement in Dispersibility of Talc in Polypropylene

Formula and Property			Formula 1	Formula 2	Formula 3
			UMEX 1001	Competitor's product	Additive-Free
Formula	Polypropylene *	mass ratio	70	70	70
	Talc (untreated)	mass ratio	30	30	30
	UMEX 1010	mass ratio		3	
	Competitor's product	mass ratio			5
Mechanical property	Flexural strength	MPa	45	44	40
	Flexural modulus	MPa	2,600	2,400	2,400
	Charpy impact strength (23 °C)	kJ/m	5	5	5
	Deflection temperature under load (1.813 MPa)	°C	83	82	80

* MFR: 9g (230 °C, 21.18 N, 10 min), injection-molding grade

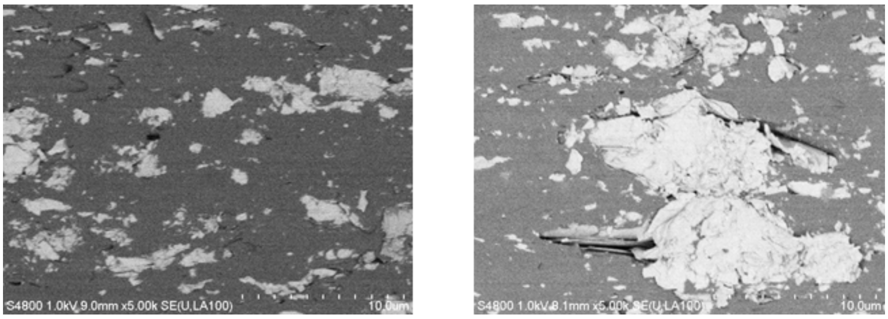
Materials and Methods:

Materials:

According to Formulas 1 to 4 described in Table 3, each of the compounds was kneaded using a twin-screw extruder at 230 °C, and then molded using an injection molding machine (nozzle temperature: 230 °C).

Methods:

Tensile stress at yield, elongation	Measured according to ASTM D 638.
Flexural strength, flexural modulus	Measured according to ASTM D 790.
Charpy impact strength	Measured with a notch according to ASTM D 256.
Deflection temperature under load	Measured with the flexural stress of 1.813 MPa according to ASTM D 648.



UMEX 1001 Added　　Additive-Free

Figure 6. Scanning Electron Micrograph of a Cross Section of Polypropylene with Dispersed Talc

2. Improvement in Adhesion of Fiberglass to Polypropylene

When either UMEX 1001 or UMEX 5200 is added to a mixture of fiberglass and polypropylene, better molded materials which exhibit a higher tensile stress at yield, a higher flexural strength and a higher flexural modulus are obtained compared with conventional molded materials containing either untreated fiberglass and acid modified polypropylene or treated fiberglass.

Adhesion of fiberglass to polypropylene is also improved as shown in the electron micrograph in Figure 7.

Table 4. Improvement in Adhesion of Fiberglass to Polypropylene

Formula and Property			Formula 1	Formula 2	Formula 3	Formula 4
			UMEX 1001	UMEX 5200	Competitor's product	Additive-Free
Formula	Polypropylene *	mass ratio	70	70	70	70
	Fiberglass (treated) **	mass ratio	30	30	30	30
	UMEX 1001	mass ratio	1			
	UMEX 5200	mass ratio		1		
	Competitor's product	mass ratio			1	
Mechanical property	Flexural strength	MPa	120	120	79	50
	Flexural modulus	MPa	5,300	5,800	4,900	3,900
	Izod impact strength (23 °C)	kJ/m	11	12	9	8

* MFR: 11g (230 °C, 21.18 N, 10 min), injection-molding grade

** Fiber length: 3mm, fiber diameter: 13μm)

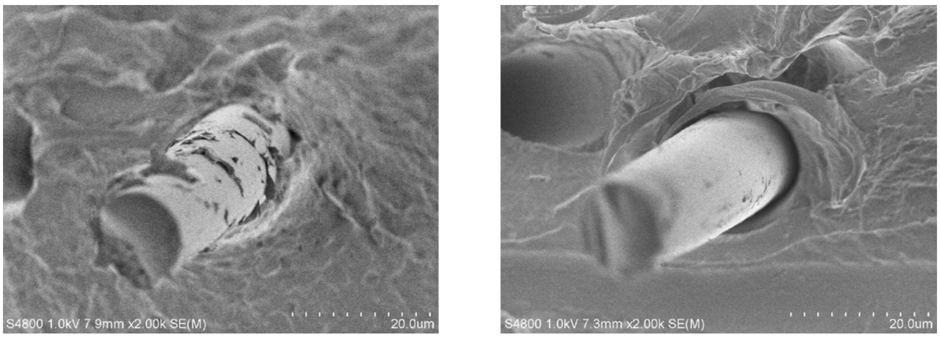
Materials and Methods:

Materials:

According to Formulas in Table 4, each of the compounds was kneaded using a twin-screw extruder at 230 °C, and then molded using an injection molding machine (nozzle temperature: 230 °C).

Methods:

Flexural strength, flexural modulus	Measured according to ASTM D 790.
Izod impact strength	Measured with a notch according to ASTM D 256.



UMEX1001 (1wt%) Added Additive-Free

Figure 7. Scanning Electron Micrograph of a Frozen Fractured Cross Section of Polypropylene with Dispersed Fiberglass

3. Improvement in Dispersibility of Calcium Carbonate in Polypropylene

When either UMEX 1001 or UMEX 1010 is added to a mixture of calcium carbonate and polypropylene, the dispersibility of calcium carbonate in polypropylene is improved and molded materials having higher tensile strength, higher flexural modulus and higher deflection temperature under load are obtained.

Table 5. Improvement in Dispersibility of Calcium Carbonate in Polypropylene

Formula and Property			Formula 1	Formula 2	Formula 3
			UMEX 1001	UMEX 1010	Additive-Free
Formula	Polypropylene *	mass ratio	50	50	50
	Ground calcium carbonate ** (untreated)	mass ratio	50	50	50
	UMEX 1001	mass ratio	2.5		
	UMEX 1010	mass ratio		2.5	
Mechanical property	Tensile strength	MPa	28.4	29.4	16.7
	Elongation	%	18	9	17
	Flexural modulus	MPa	2,700	2,750	2,650
	Deflection temperature under load (0.451 MPa)	°C	120	117	114

* MFR: 9g (230 °C, 21.18 N, 10 min), injection-molding grade

** Available on the market

Materials and Methods:

Materials:

According to Formulas 1 to 3 described in Table 5, each of the compounds was kneaded using a twin-screw extruder at 210 °C, and then molded using an injection molding machine (nozzle temperature: 210 °C).

Methods:

Tensile strength, elongation, flexural modulus	Measured according to ASTM D 638.
Deflection temperature under load	Measured with the flexural stress of 0.451 MPa according to ASTM D 648.

4. Improvement in Dispersibility of Cellulose Filler in Polypropylene

When either UMEX 1001 or UMEX 1010 is added to a mixture of cellulose type filler and polypropylene, the dispersibility of cellulose filler in polypropylene is improved and molded materials having higher tensile strength, higher flexural modulus and higher deflection temperature under load are obtained.

Table 6.　Improvement in Dispersibility of Cellulose Filler in Polypropylene

Formula and Property			Formula 1	Formula 2	Formula 3
			UMEX 1001	UMEX 1010	Additive-Free
Formula	Polypropylene *	mass ratio	50	50	50
	Pulp **	mass ratio	50	50	50
	Umex 1001	mass ratio	2.5		
	Umex 1010	mass ratio		2.5	
Mechanical property	Tensile strength	MPa	49.0	48.0	35.3
	Elongation	%	5	4	4
	Flexural modulus	MPa	4,800	4,900	4,600
	Izod impact strength (23 °C)	kJ/m	3	2	3
	Deflection temperature under load (0.451 MPa)	°C	156	155	149

*　MFR: 20g (230 °C, 21.18 N, 10 min), injection-molding grade
** Available on the market, granulated to use as fillers

Materials and Methods:

Materials:

According to Formulas 1 to 3 described in Table 6, each of the compounds was kneaded using a twin-screw extruder at 210 °C, and then molded using an injection molding machine (nozzle temperature: 210 °C).

Methods:

Tensile strength, elongation, flexural modulus	Measured according to ASTM D 638.
Izod impact strength	Measured with a notch according to ASTM D 256.
Deflection temperature under load	Measured with a flexural stress of 0.451 MPa according to ASTM D 648.

5. Improvement in Dispersibility of Wood Flour in Polypropylene

As shown in Table 7, when UMEX 1010 is added to a mixture of wood flour and polypropylene, the dispersibility of wood flour in polypropylene is improved and molded materials having a higher tensile strength, a higher flexural modulus and a higher deflection temperature under load are obtained.

Table 7.　Improvement in Dispersibility of Wood Flour in Polypropylene

Formula and Property			Formula 1	Formula 2
			UMEX 1010	Additive-Free
Formula	Polypropylene *	mass ratio	50	50
	Wood flour **	mass ratio	50	50
	UMEX 1010	mass ratio	2	
Mechanical property	Tensile strength	Mpa	43	24
	Bending strength	Mpa	68	40
	Flexural modulus	Mpa	2,800	2,700
	Izod impact strength (23 °C)	kJ/m	3	2

*　MFR: 11g (230 °C, 21.18 N, 10 min), injection-molding grade
** Cedar (Average grain diameter: 200μm)

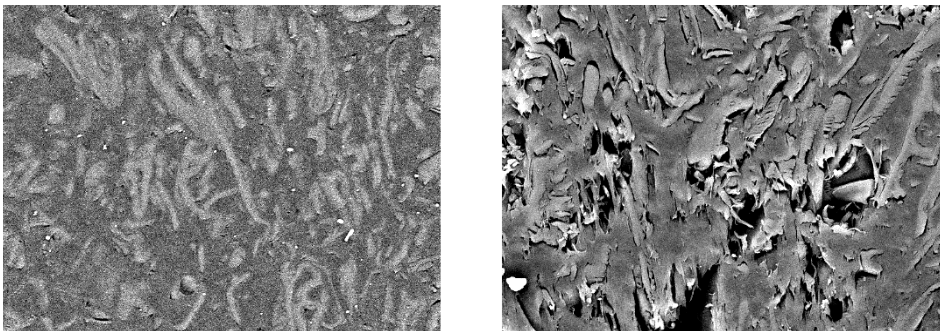
Materials and Methods:

Materials:

According to Formulas 1 to 2 described in Table 7, each of the compounds was kneaded using a twin-screw extruder at 200 °C, and then molded using an injection molding machine (nozzle temperature: 210 °C) .

Methods:

Tensile strength	Measured according to ASTM D 638.
Bending strength, Flexural modulus	Measured according to ASTM D 790.
Izod impact strength	Measured with a notch according to ASTM D 256.



UMEX1001 (2wt%) Added　　　　Additive-Free

Figure 8.　Scanning Electron Micrograph of a Cross Section of Polypropylene with Wood flour

6. Improvement in Molding Processability on ABS Resin

UMEX 110TS and UMEX 1010 improve fluidity and release properties of ABS resin when one of the products is added to the resin.

Table 8. Improvement in Molding Processability on ABS Resin

Formula and Property			Formula 1	Formula 2	Formula 3
			UMEX 110TS	Competitor's product	Additive-Free
Formula	ABS resin *	mass ratio	100	100	100
	UMEX 110TS	mass ratio	3		
	Competitor's product	mass ratio		3	
Moldability	MFR (220 °C, 98 N, 10 min)	g	36	28	22
	Release property	°	87	81	80
Mechanical property	Tensile strength	MPa	44	45	45
	Elongation	%	20	10	27
	Charpy impact strength (23°C)	kJ/m^2	19	18	22
	Deflection temperature under load (1.813 MPa)	°C	80	79	79

* MFR: 17g (220 °C, 98 N, 10 min)

Materials and Methods:

Materials:

According to Formulas 1 to 3 described in Table 8, each of the compounds was kneaded using a twin-screw extruder at 230 °C, and then molded using an injection molding machine (nozzle temperature: 210 °C).

Methods:

MFR

MFR was measured according to ISO 1133 (ASTM D 1238).

Release property

Release property was measured by the θ/2 method using a contact angle meter.

Mechanical property

See Table 3.

Other precautions

Moisture absorption may cause quality deterioration. Store in an airtight container in a dry place.

Important :

Before handling these products, refer to the Safety Data Sheet for recommended protective equipment, and detailed precautionary and hazards information.

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