Hydrated Inorganic Flame Retardant for Plastic and Rubber

SEM photograph of a fractured PP surface filled with KISUMA 5

KISUMA 5

Kyowa Chemical Industry Co., Ltd.
Kisuma Chemicals B. V.

KYOWA CHEMICAL INDUSTRY CO.,LTD

KISUMA CHEMICALS

Magnesium Hydroxide

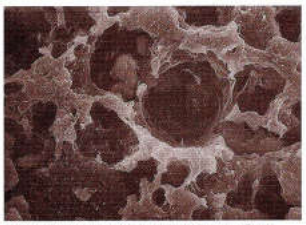
Features

Excellent as a flame retardant.
Can be used with all thermoplastic resins.
Eliminates toxic gas emissions and reduces smoke emissions.
Improves arc and tracking resistance.
Reinforces falling ball impact strength.
Improves the melt flow index, flexural modulus,
Izod impact strength and other properties of the resins.
Also effective as a heat stabilizer for resins containing halogen.

Introduction

Plastics are generally protected against flammability by the combined use of halogenated hydrocarbons and antimonytrioxide. However the use of flame retardants causes problem, such as corrosion of molding machines, emission of smoke and generation of toxic fumes during processing and combustion. Hence, much attention has been paid to materials such as aluminum hydroxide which are nontoxic and are free of these problems. Aluminum hydroxide, however, begins to dehydrate at about 180°C, making it unusable for thermoplastic resins like PP whose molding temperature is around 200°C minimum. KISUMA 5, on the other hand, begins to dehydrate at about 340°C and is therefore suitable for such resins.
KISUMA 5 is an inorganic flame retardant which does not generate poisonous or corrosive gas, thus eliminating the two biggest problems of conventional flame retardants. In addition, KISUMA 5 reduces the amount of smoke generated during combustion.
KISUMA 5 our latest magnesium hydroxide with superfine particles and no aggregation—was developed as a flame retardant through Kyowa Chemical Industry Co., Ltd.'s vast experience in manufacturing magnesium hydroxide for medical and industrial use. Magnesium hydroxide is an ideal flame retardant since it begins to dehydrate at about 340°C—a temperature which adequately overlaps with the decomposition and combustion temperature of plastics. In addition, unlike conventional magnesium hydroxides, KISUMA 5 has an excellent compatibility with plastics so high quality composites can be produced.


57wt. % of KISUMA 5A／PP (SEM: X5000)


50wt. % of a conventional $Mg(OH)_2$／PP (SEM: X5000)

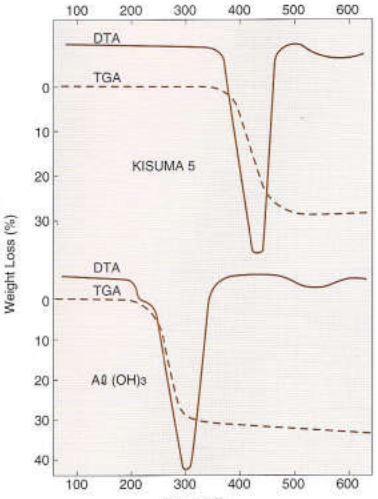
Properties of KISUMA 5

Cl (wt. %)	0.04
CaO (wt. %)	0.05
Dry loss (at 120°C for 1hr.) (wt. %)	0.06
Specific surface area (BET) (m^2/g)	4-7
Crystal size (μm)	0.6-1.0
Average secondary particle size (μm)	0.6-1.0
Mohs hardness	2.5
Specific gravity	2.4
Refractive index	1.56-1.58
Temperature (°C) of commencing dehydration	340
Amount of heat absorbed (cal/g)	312

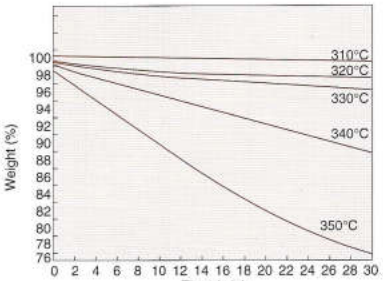
Feature

KISUMA 5A : Water-and acid-resistivity are good. (for Polyolefin)
KISUMA 5B : Low temperature flexibility and mechanical properties are excellent. (for Polyolefin)
KISUMA 5B-1 : Tensile strength is excellent. (for Polyolefin)
KISUMA 5E : Compatibility with polyamide is good. (for Nylon)
KISUMA 5J : Water-and acid-resistivity are excellent. (for Polyolefin)

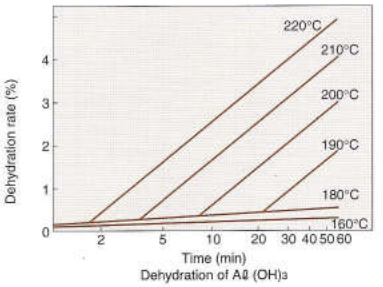
Thermal properties



Comparative DTA/TGA analysis of KISUMA 5 and Aℓ (OH)3



Dehydration of KISUMA 5



Dehydration of Aℓ (OH)3

These figures show that aluminum hydroxide begins to dehydrate at about 180°C, and in contrast, KISUMA 5 does not start to dehydrate until the temperature is about 340°C and does not reach peak dehydration until the temperature is about 430°C.

Properties of composites

1. Polypropylene

Composition (PHR)

Ethylene-propylene copolymer		100	100	100	92	100	100	100
EVA (VA: 20%)		0	0	0	8	0	0	0
KISUMA 5A		0	150	125	30	210	0	0
KISUMA 5B		0	0	0	0	0	150	0
KISUMA 5J		0	0	0	0	0	0	160
Carbon black		0	0	2.5	5	0	0	0
Red phosphorus (small particles)		0	0	0	10	0	0	0
DLTP		0	0.25	0.25	0.25	0.25	0.25	0.25
Irganox 1010		0	0.25	0.25	0.25	0.25	0.25	0.25
Kneading times		0	1	1	1	1	1	1
Shrinkage at injection molding	flowing direction (%)	1.6	1.0			0.9		
	right direction (%)	2.0	1.1			1.1		
Density	(g/cm³)	0.90	1.4		1.1	1.55	1.4	
Flammability (UL·94·VE)	1/8 inch		V-0	V-0	V-0	V-0	V-0	V-0
	1/16 inch					V-0		
Tensile yield strength	(kgf/cm²)	300	190	200	230	180	190	190
Elongation at break	(%)	700	30	80	200	5	30	20
Flexural strength	(kgf/cm²)	400	370	390	370	360	370	370
Flexural modules	(kgf/cm²)	140	480	440	180	660	450	480
Notched izod impact strength	(kgf·cm/cm)	14	13	16	13	5	13	10
Du pont impact strength	(kgf·cm)	>200	>200	>200	>200	>200	>200	>200
Heat deflection temp.	(°C)	60	68				69	
M. F. I.	(g/10min)	2.6	6	6	2	5	6	4
Rockwell's hardness		68	69					
Arc resistance	(sec)	126	189					
Tracking resistance	(V)	>600	>600				>600	
Volume resistivity	before soaked in water 23°C 50% RH (Ω·cm)	1×10^{17}	1×10^{16}				1×10^{16}	2×10^{16}
	after soaked in water (95°C× 48hrs) (Ω·cm)	3×10^{16}	1×10^{15}				4×10^{14}	2×10^{15}
Coefficient of thermal conductivity (Kcal/m.hr.deg) (at 35°C)			0.51					
CO_2 gas resistance (24°C×48hrs in water)	PH		4.4		4.05		6.0	4.2
	MgO Elusion (ppm)		5		0.4		350	3.0
HCl resistance (10^{-1} N-HCl, 30°C×7 days) dissolved $Mg(OH)_2$	(%)		7.8					0.3

Flame retardancy assistants of KISUMA 5

2. Nylon

Composition

Nylon 6 (wt. %)	100	80	70	65
KISUMA 5E (wt. %)	0	20	30	35

Tensile strength (kgf/mm^2)	Dry	6.31	7.20	8.46	8.15
	Wet	5.15	6.27	7.31	6.87
Elongation (%)	Dry		2		
Flexural strength (kgf/mm^2)	Dry	9.7	11.5	14.4	14.7
	Wet	6.3	8.8	10.8	11.5
Flexural modulus (kgf/mm^2)	Dry	208	346	416	455
	Wet	125	231	302	331
Deflection (mm)	Dry	8.3	7.0	6.8	5.6
	Wet	9.6	8.2	8.5	8.4
Notched izod impact strength (3.2mm) [kgf·cm/cm]	Dry	3.2	3.3	3.1	3.1
	Wet	8.2	7.1	5.5	4.5
Melt flow index (g/10min.)		5.5	4.4	3.3	2.8
Rockwell's hardness		97.5	98	104.5	104.5
Heat deflection temp. (°C)		104.9	126.0	125.5	140.5

3. EVA (phr)

KISUMA 5	150
EVA (VA: 41%)	100
DCP	2
NUC A-172	1
IRGANOX 1010	1

	TENSILE STRENGTH		ELONGATION
	at yield kgf/mm^2	at break kgf/mm^2	at break %
KISUMA5	1.59	1.56	210
KISUMA5B-1	1.29	1.24	250
KISUMA5B	0.55	0.69	580
KISUMA5A-1	0.91	0.90	280
KISUMA5A	0.51	0.65	470
KISUMA5J	0.63	0.77	580
Aluminum hydroxide	0.67	0.60	350

1. Nylon 6

Flame retardancy assistant	KISUMA 5E	Nylon 6	Flammability (UL-94-VE 1/16inch)
———	64%	36%	V-0
5% Red phosphorus	25%	70%	V-0
5% Red phosphorus 1.3% Epoxy resin	10%	84%	V-0

2. EEA

No	Composition				
	KISUMA 5A (PHR)	Red Phosphorus (PHR)	EEA (PHR)	DCP (PHR)	Irganox 1010 (PHR)
①	125	—	100	3	1
②	150	—	100	3	1
③	85	5	100	3	1
④	100	10	100	3	1

No	Properties					LOI
	Tensile yield strength (kgf/cm^2)	Elongation at yield (%)	Tensile breaking strength (kgf/cm^2)	Elongation at break (%)	Volume resistivity (Ωcm)	
①	75	29	134	470	3×10^{15}	26.2
②	68	28	110	440	3×10^{15}	28.6
③	68	46	145	450	4×10^{15}	33.0
④	71	36	133	450	3×10^{15}	38.5

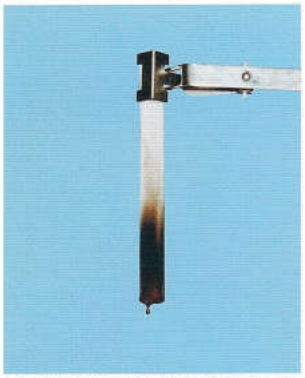
3. ABS

ABS 1			100		100	
ABS 2				100		100
Kisuma 5 B			10	10	10	10
Red phosphorus	small particles		10	10		
	large particles				10	10
Carbon black			5	5	5	5
A. O.			0.2	0.2	0.2	0.2
Zn-St			1	1	1	1
Ts at y		Kgf/mm^2	4.10	3.86	3.79	3.53
E		%	10	8	16	9
Flex. s.		Kgf/mm^2	6.44	6.06	6.15	5.82
Flex. m.		Kgf/mm^2	275	257	267	256
UL 94 VE	1/8	inch	V-0	V-0	n. a.	n. a.
	1/12	inch	V-1	V-1	n. a.	n. a.
	1/16	inch	V-1	n. a.	n. a.	n. a.

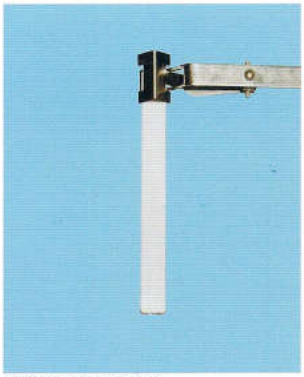
The values presented in this catalogue are not guaranteed but are typical data.

Flame retardancy and smoke-emission

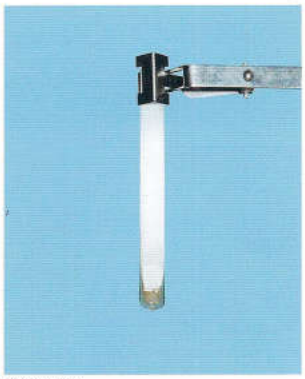
1. Flammability



30% Decabrombenzen and 10% Sb_2O_3 filled PP

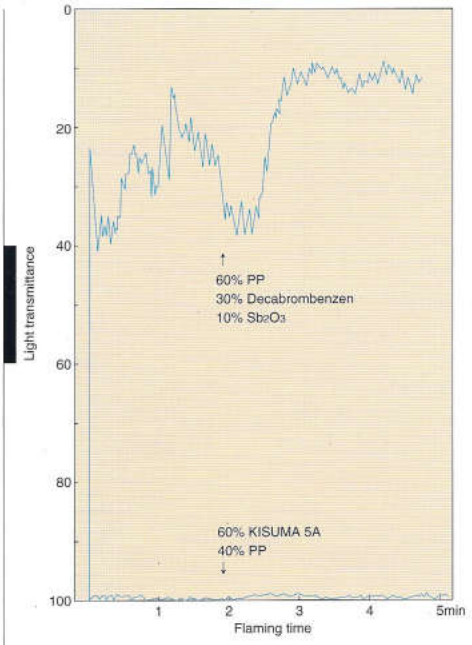


60% KISUMA 5A filled PP

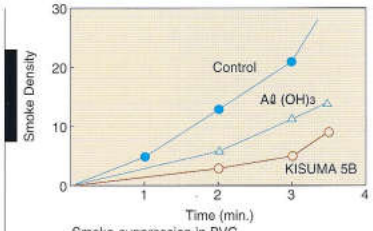


Control (PP)

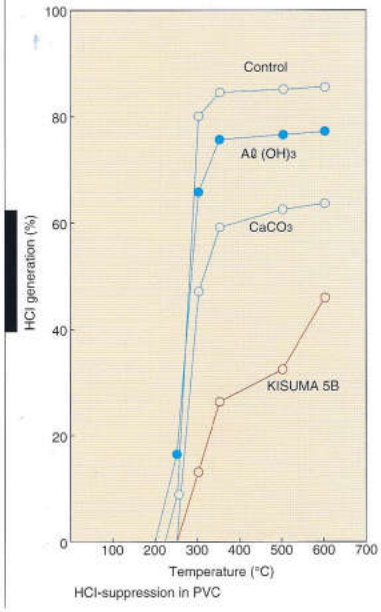
2. Smoke-emission



Test method: JIS D1201
(Flammability for organic materials in car.)



Smoke-suppression in PVC
Smoke density curves obtained from JIS-A 1321 method for PVC containing 29% of fillers.



HCl-suppression in PVC

Kyowa Chemical Industry Co., Ltd.
Research & Development Department:
4285, Hayashidacho, Sakaide, Kagawa 762-0012, Japan
Phone +81(0)877-47-2500 Fax +81(0)877-47-4750 e-mail 〈rd@kyowa-chem.co.jp〉

Kisuma Chemicals B. V.
Billitonweg 7, 9641 KZ Veendam, the Netherlands
Phone +31(0)598-666-766 Fax +31(0)598-690-792 e-mail 〈info@kisuma.com〉

KYOWA CHEMICAL INDUSTRY CO.,LTD

KISUMA CHEMICALS

2001. 8. 1000