

February 18, 2009

ADK STAB FP-2200

- Flame retardant for polyolefins -

ADK STAB FP-2200 is a newly developed nitrogen-phosphorus based flame retardant used mainly for polyolefins and has the following advantages

<Features>

- **FP-2200** is recommended for use in polypropylene (PP) homopolymer and copolymer, high and low density polyethylene (PE), ethylene vinyl acetate copolymer and others.
- **FP-2200** can provide polyolefins with excellent flame retardancy by formation of intumescences, which reduces the generation of both dark smoke and CO gas during combustion.
- **FP-2200** provides flame retarded polyolefins with low density and high mechanical properties.
- An appropriate light stabilizer to give the excellent light stability to the flame retarded polymer is available in **FP-2200** system.

<Recommendation for processing >

- ◆ Suitable extrusion and injection molding temperatures of the polymers containing **FP-2200** are below 230°C.
- ◆ Acid-resistant processing machines have to be used for extrusion and molding since **FP-2200** is acidic in nature.

1. Material Data of ADK STAB FP-2200

Typical Physical and Chemical Properties

Appearance:	White powder
Melting point:	Not observed up to 270°C
Nitrogen content:	19 - 23 %
Phosphorus content:	16 - 21 %
Volatility:	TG Analysis (10°C/min., in air) 1% weight loss : above 260°C 5% weight loss : above 285°C
Average particle size:	under 10µm (wet laser diffractometry, methanol dispersion)
Bulk density:	0.35 - 0.55 g/ml
pH	3.0 - 4.0 (10% suspension in water at 25 °C)

*The above values are typical, not specific.

Handling and Storage

- ♦ This product tends to absorb moisture. Store in the original container securely under cool and dry condition.
- ♦ Protective clothing should be worn when operators are handling, or being exposed to, this product. See the MSDS for further detailed advice.

2. Flame retardancy

ADK STAB FP-2200 can provide polyolefins with UL-94 V-0 rating at lower concentration as compared with other intumescent-type flame retardants (Table 1,2).

Table1. Dosage for V-0 rating of flame retarded PP

Flame retardant		FP-2200		Mg(OH) ₂
PTFE (0.2%)		with	without	
UL-94V (1.6mm)	PP-h	18%	23%	over 60%
	PP-b	18%	25%	over 60%

1) PP-h [MI=8dg/min] (100) / ADK STAB AO-60(0.1) / ADK STAB 2112(0.1) / Ca-St(0.1)

2) PP-b [MI=8dg/min] (100) / ADK STAB AO-60(0.1) / ADK STAB 2112(0.1) / Ca-St(0.1)

*Extrusion @ 220°C, Injection – molding @ 220°C - 50°C,

Table2. Dosage for V-0 / VTM-0 rating of flame retarded LDPE

Flame retardant		FP-2200	Mg(OH) ₂
UL-94V	1.6mm	-	over 60%
	0.8mm	31%	-
UL-94VTM	0.3mm	31%	-
	0.2mm	37%	-

LDPE [MI=1.5dg/min] (100) / ADK STAB AO-60(0.1) / ADK STAB 2112(0.1) / Ca-St(0.1) / antiblock agent (0.3)

*Extrusion @ 160°C, Injection – molding @ 160°C - 40°C,

3. Reduction of the smoke / CO gas generation during combustion

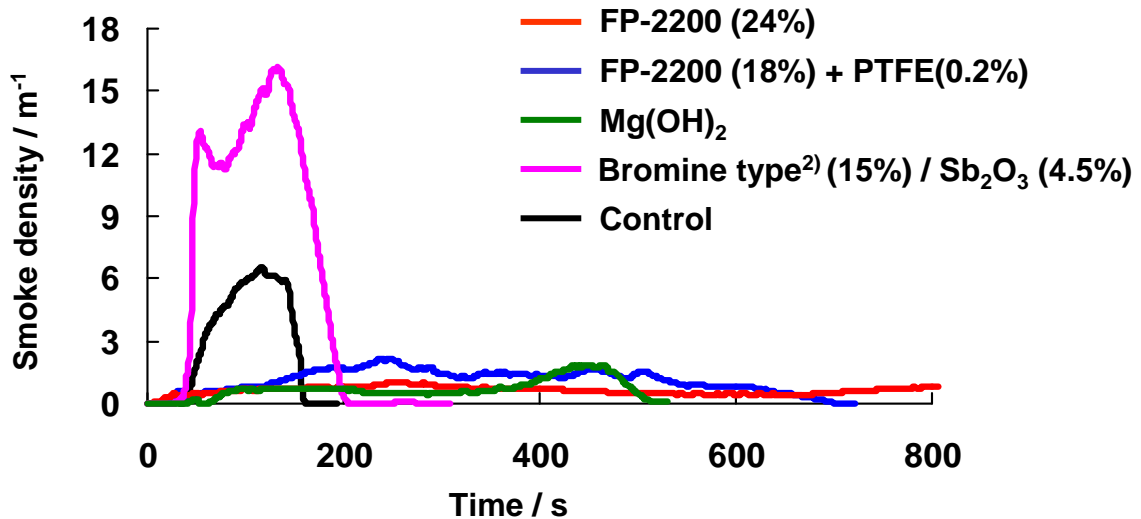


Figure 1. Smoke density curves of flame retarded PP-h¹⁾ at 50kW/m² heat flux.

1) PP-h [MI=8dg/min] (100) / ADK STAB AO-60(0.1) / ADK STAB 2112(0.1) / Ca-St(0.1)

2) Bis(pentabromodiphenyl)ethane

*Extrusion @ 220°C, Injection – molding @ 220°C - 50°C

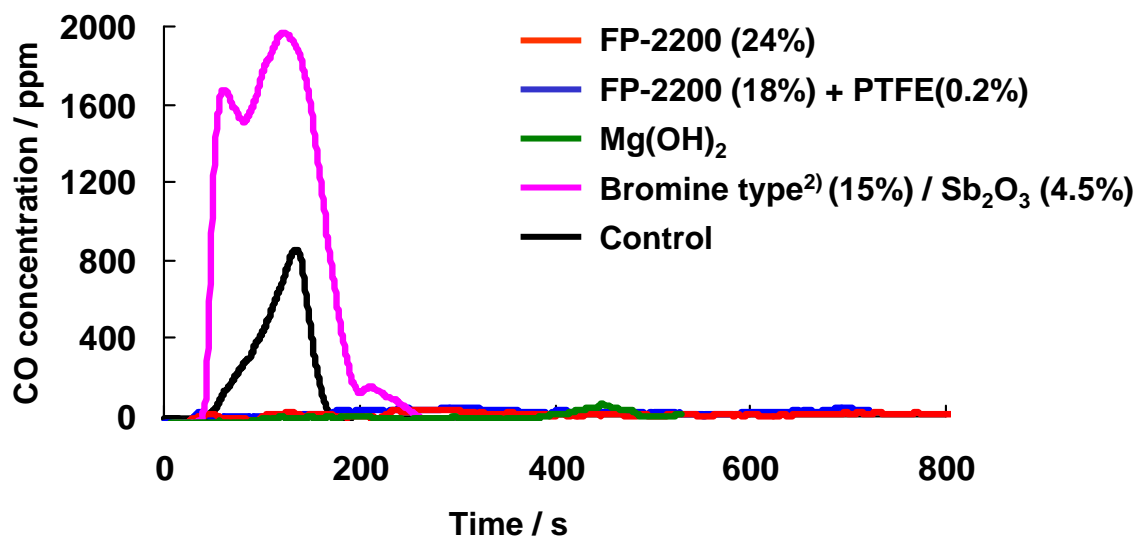


Figure 2. CO concentration of flame retarded PP-h¹⁾ at 50kW/m² heat flux.

1) PP-h [MI=8dg/min] (100) / ADK STAB AO-60(0.1) / ADK STAB 2112(0.1) / Ca-St(0.1)

2) Bis(pentabromodiphenyl)ethane

*Extrusion @ 220°C, Injection – molding @ 220°C - 50°C

4. Physical / mechanical properties

ADK STAB FP-2200 provides flame retarded polyolefins with low density and high mechanical properties.

4-1. Flame retarded PP (Table3,4)

Table3. Flame retardant formulation on PP-h

Component	Formulation				
	H1	H2	H3	H4	H5
PP-h ¹⁾ + stabilizers ²⁾	100	72	78.8	40	60.5
FP-2200		24	18		
Mg(OH)₂				60	
Bromine type / Sb₂O₃ ³⁾					19.5
Talc					20
PTFE ⁴⁾			0.2		

1) MI=8dg

2) ADK STAB AO-60(0.1) / ADK STAB 2112(0.1) / Ca-St(0.1)

3) Bis(pentabromodiphenyl)ethane / Sb₂O₃ = 15 / 4.5

4) Polytetrafluoroethylene

Table4. Mechanical properties & flammability of flame retarded PP-h

Criteria	Condition	Unit	Formulation				
			H1	H2	H3	H4	H5
Density	ISO1183	kg/m ³	901	1037	997	1436	1250
Tensile modulus	ISO527-1	GPa	1.16	1.78	1.68	2.88	2.86
Tensile elongation @ brake	ISO527-1	%	160	33	23	1	10
Flexural modulus	ISO178	GPa	1.57	2.24	2.32	4.58	4.08
Flexural strength	ISO178	Mpa	42	41	48	34	55
Charpy Impact strength	ISO179, 23°C	kJ/m ²	0.8	1.3	1.1	3.0	1.1
HDT	ISO75-2, 0.45MPa	°C	80	112	113	110	130
Flame retardancy	UL94V, 1.6mm		NR	V-0	V-0	NR	V-2

4-2. Flame retarded LDPE (Table. 5,6)

Table5. Flame retardant formulation on LDPE

Component	Formulation			
	L1	L2	L3	L4
LDPE ¹⁾ + stabilizers ²⁾	99.7	64.7	62.7	39.7
FP-2200		31	33	
Mg(OH)₂				60
N,N-Ethylene bis(stearamide)	0.3	0.3	0.3	0.3

1) MI=1.5dg

2) ADK STAB AO-60(0.1) / ADK STAB 2112(0.1) / Ca-St(0.1)

3) Bis(pentabromodiphenyl)ethane / Sb₂O₃ = 15 / 4.5

4) Polytetrafluoroethylene

Table6. Physical and Mechanical properties of flame retarded LDPE

Criteria	Condition	Unit	Formulation			
			L1	L2	L3	L4
Density	ISO1183	kg/m ³	915	1085	1093	1421
Tensile modulus	ISO527-1	MPa	180	325	315	530
Tensile elongation @ brak	ISO527-1	%	77	34	35	7.5
Flame retardancy	UL-94V, 1.6mm		NR	V-0	V-0	NR
	UL-94V, 0.8mm		NR	V-0	V-0	NR

5. Weatherability

Appropriate light stabilizer to give the excellent light stability to the flame retarded polymer is available in FP-2200.

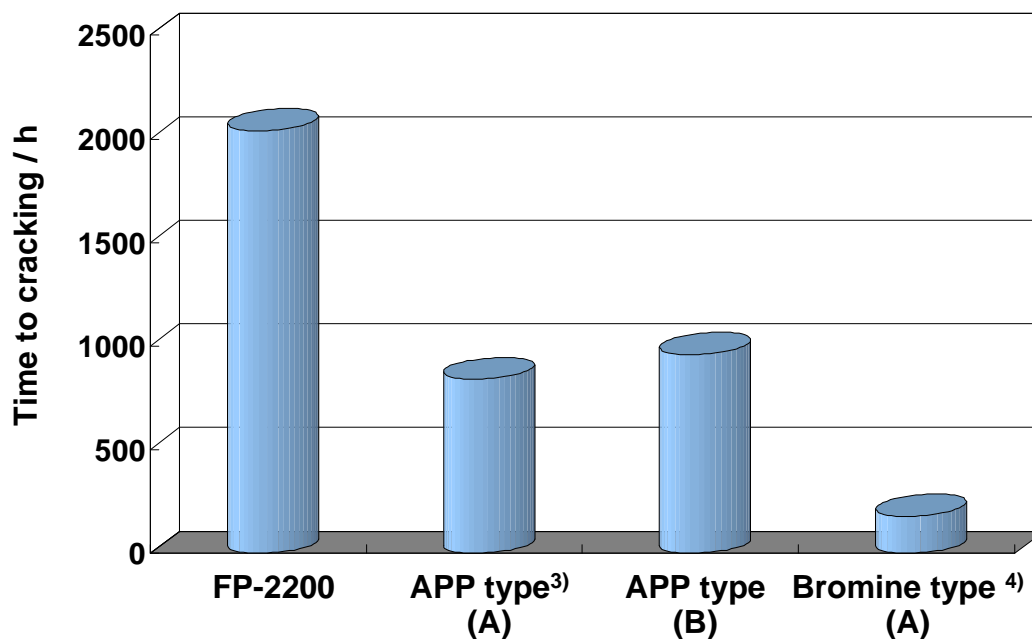


Figure 3. Light stability of flame retarded PP-b¹⁾ with small amount of light stabilizers²⁾. Artificial exposure in Xenon weather meter at 65°C with spray.

1) PP-b [MI=8dg/min] (100) / ADK STAB AO-60(0.1) / ADK STAB 2112(0.1) / Ca-St(0.1)

2) ADK STAB LA-502 (0.1) & conventional UVA (0.1).

3) Ammonium polyphosphate

4) Decabromo-diphenylether

*Extrusion @ 220°C, Injection – molding @ 220°C - 50°C