

New Generation Plastic Flame Retardants



Inovia Materials LLC
Product Application Example

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PMMA Retardant AR-S11

Materials:

PMMA: Arkema V040

Flame retardant: Inovia AR-S11

Processing Conditions:

1. Drying: 80°C for 4h in a vacuum oven
2. Extrusion Temperature: 210~230°C. Twin screw extrusion machine with side liquid feeding device

Note: AR-S11 can reduce the viscosity of plastic melt and hence the extrusion temperature can be reduced accordingly. Too high extrusion temperature or shearing force need to be avoided.

3. Injection Temperature: 215~230°C, mold temperature: 60°C

Flame Retarding Performance:

Loading Level	UL 94 Rating
4%	1.6mm V2
7%	0.8mm V0
9%	1.6mm V0

Physical Properties:

PMMA Physical Properties (1.6mm V0)

	Test Standard	Test Condition	Value
Tensile Strength at Yield	ISO 527	50mm/min	55.7Mpa
Elongation at break	ISO 527	50mm/min	8.4%
Flexural Strength	ISO 178	2mm/min	66Mpa
Flexural Modulus	ISO 178	2mm/min	2067Mpa
Charpy Impact resistance	ISO 179 -1eU	4J	18.7KJ/m2
Vicat softening Point	ISO 306	50°C/h 10N	94.03°C

HDT	ISO 75	0.45MPa	74.9°C
Glass transition temperature			106.8°C
Melt Index	ISO 1133	230°C / 3.8kg	13.3g/10min
Fire Resistance	UL94	1.6mm	V0
Color value	L		95.97
	A		-0.2
	B		1.25
Light transmittance	GB/T 2410	1.6mm	92.37%
Haze	GB/T 2410	1.6mm	0.57%
YI	ASTM E313	1.6mm	1.78

PMMA Physical Properties (0.8mm V0)

	Test Standard	Test Condition	Value
Tensile Strength at Yield	ISO 527	50mm/min	56.8Mpa
Elongation at break	ISO 527	50mm/min	9.2%
Flexural Strength	ISO 178	2mm/min	84 Mpa
Flexural Modulus	ISO 178	2mm/min	2701.48 Mpa
Charpy Impact resistance	ISO 179/ -1eU	4J	19.2 Mpa
Vicat softening Point	ISO 306	50°C/h 10N	102.1°C
HDT	ISO 75	0.45MPa	79.9°C
Melt Index	ISO 1133	230°C / 3.8kg	7.2g/10min
Fire Resistance	UL94	0.8mm	V0
Color value	L		95.97
	A		-0.2

	B		1.05
Light transmittance	GB/T 2410	1.6mm	92 %
Haze	GB/T 2410	1.6mm	0.5%
YI	ASTM E313	1.6mm	1.58

PMMA Physical Properties(1.6mm V2)

	Test Standard	Test Condition	Value
Tensile Strength at Yield	ISO 527	50mm/min	61.4Mpa
Elongation at break	ISO 527	50mm/min	9.8%
Flexural Strength	ISO 178	2mm/min	82.5 Mpa
Flexural Modulus	ISO 178	2mm/min	2634.8 Mpa
Charpy Impact	ISO 179	4J	18.4 Mpa
Vicat softening Point	ISO 306	50°C/h 10N	108.1°C
HDT	ISO 75	0.45MPa	89.9°C
Melt Index	ISO 1133	230°C / 3.8kg	5.91g/10min
Fire Resistance	UL94	1.6mm	V2
Color value	L		94.98
	A		-0.18
	B		1.09
Light transmittance	GB/T 2410	1.6mm	92 %
Haze	GB/T 2410	1.6mm	0.5%
YI	ASTM E313	1.6mm	1.62

PMMA Retardant Masterbatch MB-AC20A

Materials:

PMMA: Arkema V040

Retardant Masterbatch: MB-AC20A

Processing Conditions:

1. Drying conditions: 80°C for 4h in a vacuum oven. (0.1Mpa)

2. Extrusion temperature: 210~230°C.

Vacuum Degree: 0.06Mpa

Screw Speed: 180-220 rpm

Feeding: 8-12kg/h

Screw Configuration: It is recommended to have as few meshing combinations as possible to reduce decomposition

3. Injection temperature: 215~230°C, mold temperature: 60°C

TPU Retardant BR-S13

Materials:

Polyether TPU: WHAHUA WHT-81085

Flame Retardants: Inovia BR-S13, BASF MC25

Processing Conditions:

1. Drying : 85°C for 4h
2. BR-S13 is mixed well with WHT-81085 , then is mixed with MC25.
3. Extrusion Temperature:175~190°C.
4. Injection Temperature: 150~165 °C, Mold temperature is 50°C

Flame Retarding Performance:

BR-S13 Loading Level	MC25 Loading Level	UL 94 Rating
3%	5%	V0@1.6mm

Mechanical Properties:

Item	Tensile Strength (MPa)	Stress at 100% Strain (MPa)	Stress at 300% Strain (MPa)	Elongation (%)
Blank 81085	25.6	5.0	8.4	524
Flame Retardant 81085	19.5	5.1	8.3	483

Note: The test standard is ASTM D 412.

Hydrolysis Resistance:

Item	Tensile Strength (MPa)	Stress at 100% (MPa)	Stress at 300% (MPa)	Elongation (%)
Blank 81085	25.6	5.0	8.4	524
Blank 81085 (80°C @168h)	17.7	3.7	7.6	529
Flame Retardant 81085	19.5	5.1	8.3	483
Flame Retardant 81085 (80°C@168h)	13.4	4.1	7.8	400
Flame Retardant 81085 (80°C@336h)	12.9	3.9	7.3	391

Note: The test temperature is 80°C at water bath.

Flame Retardant Formulations for Different TPU Substrates:

	BR-S13	MC25	UL 94 Rating
WHAHUA Polyester WHT-1185EC	2%	4%	V0@1.6mm
HUNTSMAN Polyether A85P 2003	4%	4%	V0@1.6mm
HUAFON Polyether HF-S4385AH-4	2%	6%	V0@1.6mm
LUBRIZOL Polyester BF85	4%	0	V0@1.6mm
LUBRIZOL Polyether 58887	2%	5%	V0@1.6mm

PA6 Retardant CR-M5110

Materials:

PA6: BASF B3S

Flame Retardant: Inovia CR-M5110

Processing Conditions:

1. Drying: PA6 is dried at 100°C for 4-6 hours
2. Extrusion temperature: 245~255°C
3. Injection Temperature: 245~265°C, Mold temperature: 60°C.

Flame Retarding Performance:

	CR-M5110 Loading Level	UL 94 (0.8mm)
Control	0	V2
Retardant	11%	V0

Physical Properties:

	Standard	Condition	Control	Retardant	Difference
Tensile Strength (MPa)	ISO 527	50mm/min	70.46	68.54	-2.7%
Breaking Elongation (%)	ISO 527	50mm/min	21.8	18.4	-15.6%
Flexural Strength (MPa)	ISO 178	2mm/min	64	81	+26.6%
Unnotched Impact	ISO 179	23°C	Unbreakable	Unbreakable	-
HDT(°C)	ISO 75	1.8MPa	50.7	61	+20.3%
CTI	IEC60112		500	600	+20%

PA66 Retardant CR-M516

Materials:

PA66: BASF A3W

Flame Retardant: Inovia CR-M516

Processing Conditions:

1. Drying : PA66 is dried at 100°C for 4-6 hours
2. Extrusion Temperature: 255~285°C
3. Injection Temperature: 255~285°C, Mold temperature: 80°C.

Flame Retarding Performance:

	CR-M516 Loading Level	UL 94 (0.8mm)
Control	0	V2
Retardant	7%	V0

Physical Properties:

	Standard	Conditio	Control	Retardant	Differenc
Tensile Strength (MPa)	ISO 527	50mm/mi	79.6	85.5	+7.4%
Breaking Elongation (%)	ISO 527	50mm/mi	30	16.6	-45%
Flexural Strength (MPa)	ISO 178	2mm/min	75	87	+16%
Unnotched Impact	ISO 179	23°C	Unbreakable	Unbreakabl	-
HDT(°C)	ISO 75	1.8MPa	69.6	80.6	+15.8%
CTI	IEC60112		500	600	+20%

PA46 Retardant CR-M518

Materials:

Base Resin: DSM KS200

Flame Retardant: Inovia CR-M518

Processing Conditions:

1. Drying: PA46 is dried at 100°C for 4-6 hours
2. Extrusion Temperature: 260~285°C
3. Injection Temperature: 270~290°C, Mold temperature: 90°C.

Flame Retarding Performance:

	CR-M518 Loading Level	UL 94 (0.8mm)
Control	0	V2
Retardant	9%	V0

Physical Properties:

	Standard	Condition	Control	Retardant	Difference
Tensile Strength (MPa)	ISO 527	50mm/min	92.2	81.7	-11.4%
Breaking Elongation (%)	ISO 527	50mm/min	59	38	-36%
Flexural Strength (MPa)	ISO 178	2mm/min	71	78	+10%
Flexural Modulus (MPa)	ISO 178	2mm/min	2051	2316	+13%
Unnotched Impact	ISO 179	23°C	Unbreakable	Unbreakabl	-
HDT(°C)	ISO 75	1.8MPa	86.4	102.3	+18.4%

PC Retardant DR-S15

Materials:

PC: Makrolon® 2805

Flame retardant: Inovia DR-S15

Processing Conditions:

1. Drying: PC Resin is dried at 120°C for 3 hours in a vacuum oven. Inovia DR-S15 can be used as provided if its package is intact

2. Extrusion temperature: 235~270°C

Note: Twin screw extruder with liquid feeding device is recommended. The liquid feeding pipe should be heated and have good insulation. The temperature of the liquid feeding device can be set at 80°C. The liquid feeding device is equipped with a nitrogen device to minimize the absorption of moisture in the air by the flame retardant. Adding DR-S15 can effectively reduce the melt viscosity and processing temperature of PC. Temperature can be lowered accordingly. Excessive extrusion temperature or shearing force need to be avoided.

3. Injection temperature: 235~270°C, mold temperature: 80°C.

Flame Retardation:

Loading Level	UL 94 Rating
5%	1.6 mm V0

Physical Properties:

	Test Standard	Test Condition	Value
Melt mass-flow rate	ISO 1133	300 °C, 1.2 kg	69.4 g/10min
Shear Viscosity	ISO 11443	300 °C, 1000 s ⁻¹	29 Pa·s
Tensile modulus	ISO 527	1 mm/min	2670 MPa
Tensile stress at yield	ISO 527	50 mm/min	69.5 MPa
Tensile strain at yield	ISO 527	50 mm/min	5.8 %
Tensile stress at break	ISO 527	50 mm/min	56.7 MPa

Tensile strain at break	ISO 527	50 mm/min	64 %
Flexural modulus	ISO 178	2 mm/min	2000 MPa
Flexural stress at 3.5%	ISO 178	2 mm/min	65.8 MPa
Charpy impact strength	ISO 179/1eU	23 °C	non-break
Izod notched impact	ISO 180-A	23 °C, 3 mm, 5.5 J	7.0 kJ/m ²
Vicat softening	ISO 306	50 °C/h, 10 N	131.6 °C
HDT	ISO 75	0.45 MPa	115.2 °C
Glass transition	ISO 11357	10 °C/min	144.2 °C
Optical properties	Standard	Test Condition	Typical Value
Color Data		L	95.79
		a	-0.36
		b	1.02
Light Transmittance	GB/T 2410	1.6 mm	88.1 %
Haze	GB/T 2410	1.6 mm	0.44 %
Yellowness Index	ASTM E313	1.6 mm	3.54

PC Retardant Masterbatch MB-PC10C

Materials:

Base Resin: Makrolon® 2805

Retardant Masterbatch: Inovia MB-PC10C

Extrusion Process:

1. Drying: PC 2805 is dried at 120°C for 3 hours in a vacuum oven.

Inovia MB-PC10C is dried at 100°C for 3h in a vacuum oven. (0.1Mpa)

2. Extrusion temperature: 220/240/240/240/230/230/230/230/240/250

Vacuum Degree: 0.06Mpa Screw Speed: 180-220 rpm

Feeding: 8-12kg/h

Screw Configuration: It is recommended to have as few meshing combinations as possible to reduce decomposition

Recommend Screw Configuration: feed end 56A 56 56 56 56 56 40 40 40 40 28 28
45/5/40 60/4/28 90/5/28 22L 56 56 56 56 40 40 40 28 28 28 45/5/40 45/5/28 28 28
45/5/28 60/4/28 45/5/28L 56 56 56 40 40 28 28 28 screw head

3. Injection Process:

Drying conditions: 105°C*3h

Injection temperature: 240/245/250/255/260

Injection pressure: 85Mpa

PBT Retardant ER-M5515

Materials:

PBT: BASF B4500

Flame Retardant: Inovia ER-M5515

Processing Conditions:

4. Drying: B4500 is dried at 120°C for 4hours, then is mixed with ER-M5515.

5. Extrusion temperature: 230~250°C

6. Injection Temperature: 215~240°C, Mold temperature: 40°C.

Flame Retarding Performance:

	ER-M5515 Loading Level	UL 94 (1.6mm)
Control	0	V2
Retardant	20.5%	V0

Physical Properties:

	Standard	Condition	Control	Retardant	Difference
Tensile Strength (MPa)	ISO 527	50mm/min	55.2	43.5	-21.2%
Flexural Strength (MPa)	ISO 178	2mm/min	60	53	-11.7%
Flexural Modulus (MPa)	ISO 178	2mm/min	1751	1846	+5.4%
Unnotched Impact (kJ/m ²)	ISO 179/4J	23°C	Unbreakable	33.4	-
HDT. (°C)	ISO 75	0.45MPa	94	134	+42.6%