

Firebrake[®] ZB in polyamides



Firebrake[®] ZB is used as a multifunctional flame retardant for polyamides in applications such as electrical connectors, bobbins, circuit breaker, housings, transformer components, and encapsulations.

Halogen-containing polyamides

Flame retardant synergist: *Firebrake* ZB acts as a synergist of halogen sources such as brominated polystyrene and dechlorane plus. Depending on the type of polyamide and halogen source used, *Firebrake* ZB can either partially or completely replace antimony trioxide or sodium antimonite to reduce the formulation cost and still maintain the UL 94 V-O performance for either unfilled or glass filled polyamides (Tables 1 and 2). In high temperature polyamides, *Firebrake* ZB can replace antimony trioxide completely.

Improve comparative tracking index (CTI): While halogen sources, antimony oxide, and glass fiber are all detrimental to CTI, *Firebrake* ZB is known to improve CTI.

Improve thermal stability: *Firebrake* ZB improves the thermal stability of the fire retardant polyamide formulations as evidenced by color stability, melt viscosity stability (Figure 1), and the polymer weight retention during processing.

Improve corrosion resistance: *Firebrake* ZB is known to alleviate corrosion life of equipment and metal substrates that are in contact with polyamides during processing.

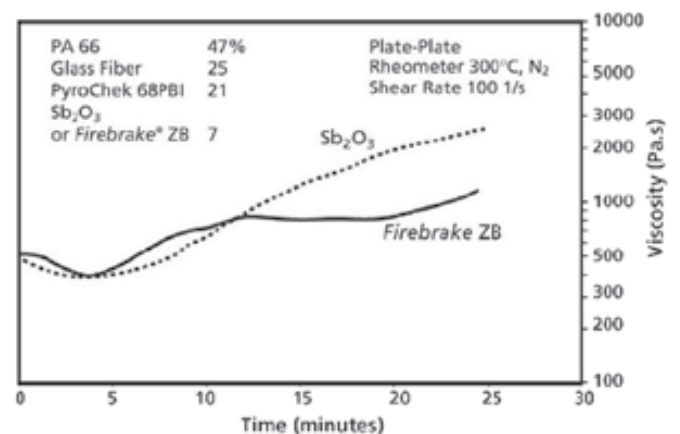
Smoke suppression: Smoke suppression is a general function of *Firebrake* ZB in any polymer system, especially in halogen-containing formulations.

Halogen-free polyamides

Firebrake ZB can help:

- Improve flame retardancy, reduce afterglow, and prevent burning drips in polyamide formulations
- Improve CTI of polyamides containing melamine polyphosphate or melamine pyrophosphate
- Improve char formation and thermal stability of polyamides, especially when containing aluminum diethylphosphinate and melamine polyphosphate
- Improve glow wire ignition temperature (GWIT) or glow wire flammability index (GWFI)
- Alleviate corrosion and suppress phosphine formation in polyamides containing red phosphorous

Figure 1: Melt viscosity stability of *Firebrake* ZB vs antimony trioxide in polyamide 6,6



BROCHURE: FIREBRAKE ZB IN POLYAMIDES

Table 1: Fire retardant non-reinforced polyamide 6,6

		Examples (wt%)			
Components		1	2	3	4
Polyamide 6,6		70	70	78	85
Dechlorane plus		20	20	16	12
Sb ₂ O ₃		10	--	2	--
Firebrake ZB		--	10	4	1.5
Ferric oxide		--	--	--	1.5
		Test results			
UL-94	3.2mm	V-0	V-0	V-0	V-0
	0.8mm	V-0	V-0	V-0	V-0
	0.4mm	V-0	V-0	V-0	V-0
CTI (volts)		275	300	450	350

Table 2: Fire retardant glass reinforced polyamide 6,6 (Sb-free)

		Examples (wt%)					
Components		1	2	3	4	5	6
Polyamide 6,6		75	54	47	47	44	44
Glass fiber		25	25	25	25	25	25
Pyro-Chek® 68PB		--	21	21	21	24	24
Sb ₂ O ₃		--	--	7	--	--	--
Firebrake ZB		--	--	--	7	7	--
		Test results - Dry as molded					
UL-94	1.6mm	NC	NC	V-0	V-0	V-0	V-0
	0.8mm	NC	NC	V-0	V-2	V-0	V-0
		Test results - Aged 168 hours at 70 °C					
UL-94	1.6mm	NC	NC	V-0	V-2	V-0	V-0
	0.8mm	NC	NC	V-0	V-2	V-0	V-0
CTI (volts)		550	325	225	375	450	475

General guidelines

Recommendations for levels of treatment depend on the desired fire test performance, type and other components of fire retardant system (either halogen-containing or halogen-free), and CTI/GWIT/GWFI required.

- In halogen-containing polyamides, a good starting-point would be the replacement of 40% of antimony trioxide with *Firebrake ZB*. If an improved fire performance is achieved, higher levels of antimony oxide replacement can be tested.
- To achieve antimony-free formulation in polyamide 6,6, a good starting point is to use about 5 to 7 wt% of *Firebrake ZB* in combination with an increased level of brominated polystyrene (by about 2 wt%).
- To improve CTI, a maximum amount of *Firebrake ZB* and minimum amount of antimony trioxide shall be used in the formulation.
- In halogen-free polyamides, about 1 to 4 wt% of *Firebrake ZB* can be used in conjunction with aluminum diethylphosphinate/melamine polyphosphate or red phosphorus.

About U.S. Borax

U.S. Borax is a global leader in the supply and science of borates—naturally-occurring minerals containing boron and other elements. We are 1,000 people serving our customers with more than 1,800 delivery locations globally. We supply around 30% of the world's need for refined borates from our world-class mine in Boron, California, about 100 miles northeast of Los Angeles.

About 20 Mule Team products

U.S. Borax produces the *20 Mule Team*® borates family of products from naturally occurring minerals and have an excellent reputation for purity and safety when used as directed. Borates are key ingredients in a number of industrial applications including fiberglass, glass, ceramics, batteries and capacitors, wood preservatives, and flame retardants.

High quality, high reliability, high performance borate products. It's what we're known for.

