BROCHURE

# Firebrake® ZB in polyamides

20 MULE TEAM BORAX™
Rio Tinto

*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.

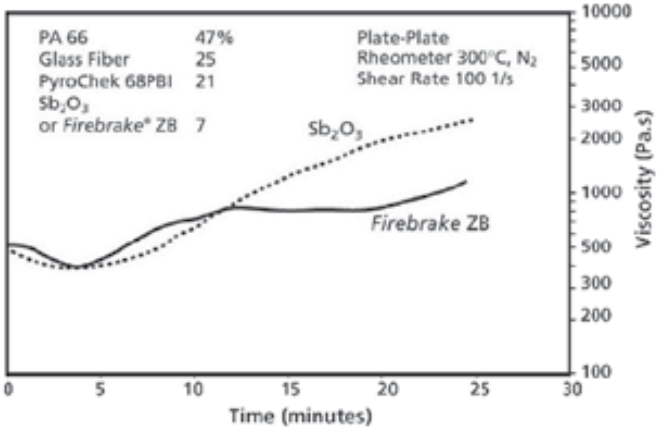
Smoke suppression: Smoke suppression is a general function of *Firebrake* ZB in any polymer system, especially in halogen-containing formulations.

## 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 |
| $Sb_2O_3$ | | 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 |
| $Sb_2O_3$ | | -- | -- | 7 | -- | -- | -- |
| *Firebrake* ZB | | -- | -- | -- | 7 | 7 | -- |
| *Firebrake* ZB-XF | | -- | -- | -- | -- | -- | 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, part of Rio Tinto, 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 650 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.

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