

Firebrake® ZB in elastomers



Firebrake ZB, a boron-based multi-functional fire retardant, has been used as a flame retardant, smoke suppressant, and afterglow suppressant in both halogen-containing and halogen-free elastomers. It has been used in applications such as wire and cables, mining belts, flooring, roofing membrane, and foamed insulation products.

Firebrake ZB has a typical median particle size of 9 microns. To enhance the fire performance and achieve the best physical properties, *Firebrake ZB* is offered in a fine grade (*Firebrake ZB-Fine*) with a typical particle size of 2.3 microns and an extra-fine grade (*Firebrake ZB-XF*) with a typical median particle size of 1.8 microns and a top particle size of 12 microns.

Flame retardant synergist

- In halogen-containing elastomers *Firebrake ZB* acts as a synergist of halogen sources and antimony oxide in the formulation. It can partially replace 25 to 50 wt% of antimony trioxide in most elastomer formulations (Tables 1 and 2) to improve Oxygen Index, UL 94 or other fire tests.
- In halogen-free elastomers *Firebrake ZB* acts as a synergist to reduce the rate of heat release and the carbon monoxide generation.

Char / Ceramic Formation

Firebrake ZB is an effective char promoter in both halogen-containing, and halogen-free elastomer formulations. When used in conjunction with a metal hydroxide such as alumina trihydrate or magnesium hydroxide, *Firebrake ZB* can function as a sintering aid to promote the formation of a strong char/ceramic residue (Table 3). The effects can be further augmented with the use of co-additives such as silicone/silica, phosphate ester, ammonium polyphosphate, etc.

Smoke suppressant

Firebrake ZB functions as a smoke suppressant in many elastomer applications.

Afterglow suppression

Firebrake ZB functions as an afterglow suppressant due to its borate moiety.

Table 1. Typical Polychloroprene Formulation

| Components | Parts by Weight |
|----------------------------------|-----------------|
| Polychloroprene | 75.0 |
| Antimony Trioxide | 15.0 |
| <i>Firebrake ZB</i> | 10.0 |
| Aluminum Trihydrate | 30.0 |
| Hard Clay | 20.0 |
| Magnesium Oxide | 4.0 |
| Ethylene Thiourea | 5.0 |
| N,N'-Diphenyl-p-Phenylenediamine | 2.0 |

Table 2. Typical SBR Conveyor Belt

| Components | Parts by Weight |
|-----------------------|-----------------|
| SBR/Natural Rubber | 100 |
| Chlorinated Paraffin | 20-25 |
| Antimony Trioxide | 2-4 |
| <i>Firebrake ZB</i> | 6-10 |
| Alumina Trihydrate | 35-60 |
| Clay | 35-60 |
| Carbon Black | 40-50 |
| Phosphate Plasticizer | 5-10 |
| Other Plasticizer | 10-15 |
| Antiozonant | 2-5 |
| Phenolic Resins | 2-4 |
| Other Curatives | 5.5 |

Table 3. Typical Halogen-Free EVA Elastomer

| Components | Parts by Weight |
|------------------------------------|-----------------|
| Ethylene-Vinyl Acetate (40-50% VA) | 100 |
| Alumina Trihydrate | 170-240 |
| <i>Firebrake ZB</i> | 10.0 |
| Magnesium Carbonate | 20.0 |
| Vinyl Silane | 2.0 |
| Mineral Oils | 8.0 |
| Zinc Stearate | 1.0 |
| Curatives | 2.0 |



General guidelines

Recommendations for levels of treatment depend on the base polymer used, the fire test performance required, the need for halogen-containing or halogen-free formulations, and the presence of other co-additives.

- In a halogen-containing elastomer, such as polychloroprene or elastomer containing chlorinated paraffin or an organobromine source, a good starting-point is the replacement of 30 to 50 wt% of antimony trioxide with *Firebrake ZB*. If equal or improved fire performance is achieved, complete antimony oxide replacement can be targeted. The beneficial interaction in fire test performance can be augmented in the presence of phosphate esters, alumina trihydrate, magnesium hydroxide, or talc.
- In halogen-free elastomers such as EPDM, SBR, and EP, a combination of alumina trihydrate or magnesium hydroxide with *Firebrake ZB* at ratios of 10:1 to 20:1 is recommended as a starting point formulation. The addition of phosphate esters, ammonium polyphosphate, silica, melamine polyphosphate, red phosphorous, etc. could further improve the fire test performance of metal hydroxide and *Firebrake ZB* combinations.
- In halogen-free silicone elastomers and thermo-plastic urethanes (TPU) *Firebrake ZB* can be used in conjunction with silica, melamine cyanurate, ammonium polyphosphate, or expandable graphite.
- For detailed formulation recommendations, please contact Rio Tinto Minerals.

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 500 customers with more than 1,700 delivery locations globally. We supply 30% of the world's need for refined borates from our world-class mine in Boron, California, about 100 miles east of Los Angeles. We pioneer the elements of modern living, including:

- **Minerals that make a difference:** Consistent product quality secured by ISO 9000:2001 registration of its integrated quality management systems
- **People who make a difference:** Experts in borate chemistry, technical support, and customer service
- **Solutions that make a difference:** Strategic inventory placement and long-term contracts with shippers to ensure supply reliability