

Firebrake ZB in flexible PVC

Firebrake[®] ZB, is a borate product used extensively as a partial or complete replacement for antimony oxide and other high-cost flame retardants in flexible polyvinyl chloride (PVC). Unlike antimony trioxide, *Firebrake* ZB's refractive index is similar to that of most polymer systems. This similarity helps maintain translucency and lower pigment loadings.



Firebrake ZB is used in applications such as wall coverings, wire and cable, roofing membranes, conveyor belts, carpet backing, auto upholstery, tenting materials and more.

Benefits of using *Firebrake* ZB in flexible PVC include:

Flame retardant synergist

Firebrake ZB is a cost-effective, multifunctional fire retardant with a stable supply source. The most efficient flame retardant function of *Firebrake* ZB is observed in its synergistic effect with antimony oxide in halogen-containing polymers, including flexible PVC.

Low-cost antimony oxide replacement

Depending on the desired fire standards, *Firebrake* ZB can either partially or completely replace antimony oxide. When used together, *Firebrake* ZB and antimony oxide display synergistic effects in fire test performance, as demonstrated in the Limiting Oxygen Index (LOI) test results (Figure 1).

Additional fire retardant fillers like alumina trihydrate (ATH), magnesium hydroxide, or magnesium carbonate can further enhance the synergistic effects (Figure 2).

Smoke suppression

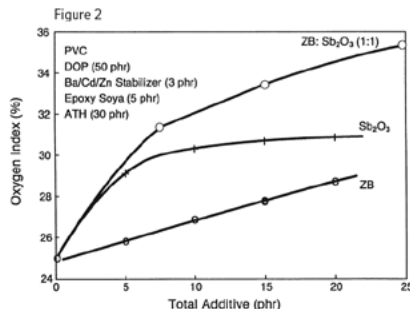
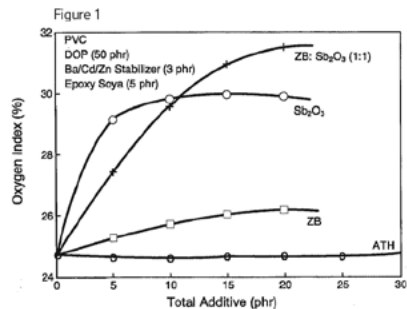
In contrast to antimony oxide, which promotes smoke formation, *Firebrake* ZB drastically reduces smoke, especially in flexible PVC (Figure 3). The reduction in smoke is also evident in the presence of ATH, even when *Firebrake* ZB is used in conjunction with antimony oxide (Figure 4). A high ratio of *Firebrake* ZB to antimony trioxide is recommended for low smoke formulations in the absence of ATH.

Afterglow suppression

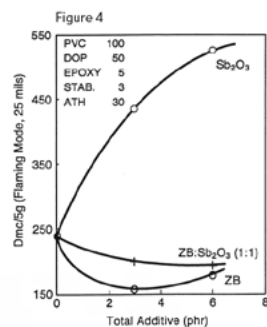
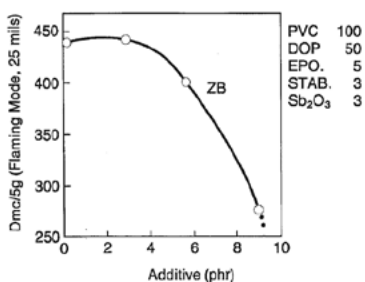
The borate component in *Firebrake* ZB forms a glassy layer on char to protect it from further oxidation and afterflow combustion.

Char promoter

During polymer combustion, the zinc component of *Firebrake* ZB catalyzes the decomposition of the halogen source to promote cross-linking and char formation. In addition, water from *Firebrake* ZB evaporates. The water cools the flame and promotes the formation of highly foamy and insulating char.



In the presence of alumina trihydrate (ATH), there is a dramatic synergism between *Firebrake* ZB and antimony trioxide. This synergism is observed at a total loading as low as 3 phr.



In the presence of alumina trihydrate (ATH), *Firebrake* ZB reduces smoke effectively, even when used with antimony trioxide. In the absence of ATH, a high ratio of *Firebrake* ZB to antimony trioxide is recommended for low smoke formulations.

General guidelines

Recommended treatment levels depend on functionality or formulation preferences, such as fire test performance, plasticizer level, or filler content:

- Replace 30-60% of the antimony oxide in your existing formulation with *Firebrake* ZB. If the revised formulation achieves equal or improved fire test performance, complete antimony oxide replacement may be possible.
- A high ratio of *Firebrake* ZB to antimony oxide is preferred for greater smoke reduction.
- For better flammability and smoke test performance, use *Firebrake* ZB in conjunction with alumina trihydrate (or magnesium hydroxide) and antimony oxide.

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 northeast of Los Angeles. We pioneer the elements of modern living, including:

- **Minerals that make a difference:** Consistent product quality secured by ISO 9001:2015 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



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