

**Firebrake<sup>®</sup>  
ZB****in flexible PVC**

*Firebrake*<sup>®</sup> 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, and tenting materials.

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.

#### 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.

# BROCHURE: FIREBRAKE ZB IN FLEXIBLE PVC

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.

Figure 1

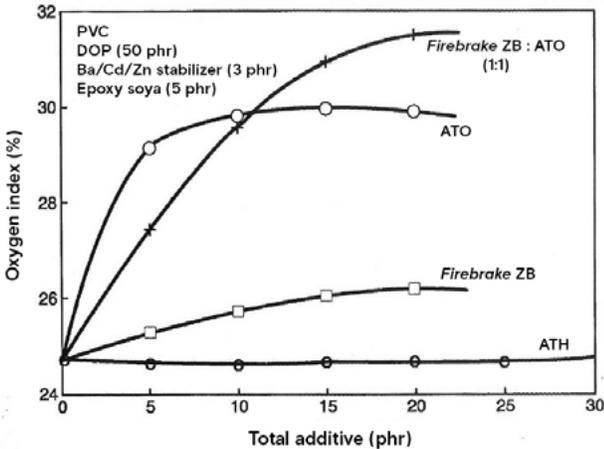
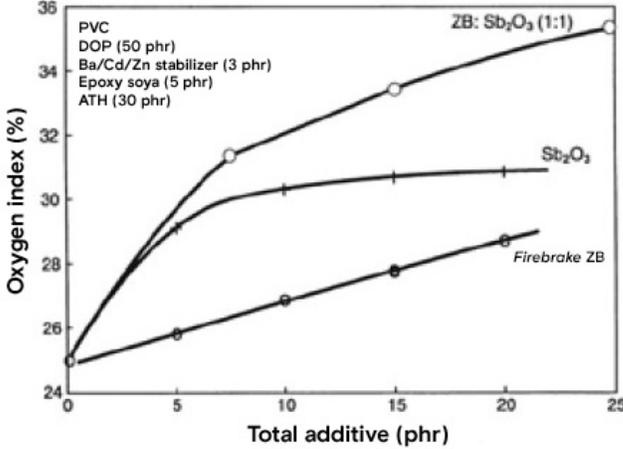


Figure 2



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.

Figure 3

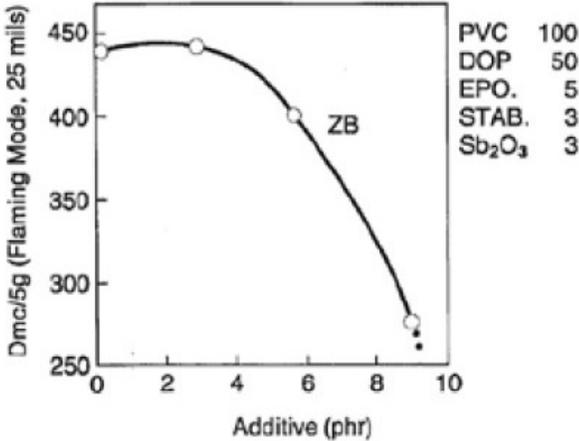
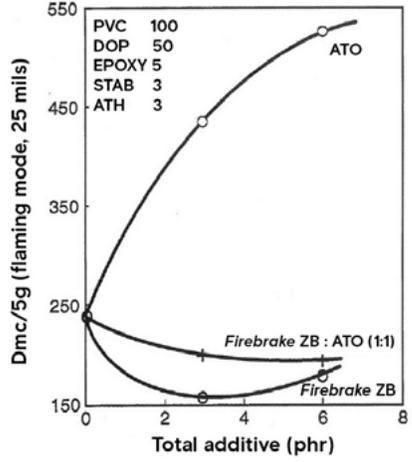


Figure 4



**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*<sup>®</sup> 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.

