



# Firebrake® for polymer fire retardancy



RioTinto

*Firebrake*® products are unique zinc borates that combine the beneficial effects of zinc and boron oxides. Multi-functional fire retardants for polymers, they can be used in applications such as construction products, electrical/electronics, transportation, fabrics, and industrial coatings.

## Why zinc borates?

Studies show that zinc borates function as flame retardants, smoke suppressants, afterglow suppressants, and anti-tracking agents in both halogen-containing and halogen-free polymers.

### Multi-functional flame retardant for polymers

In halogen free systems, zinc borates can be used either alone or in combination with other flame retardants such as metal hydroxides (ATH, MDH), phosphorus, and silicone. They promote:

- Char/residue formation
- Stabilization of the char and inhibition of the oxidation of the char (afterglow suppression)
- Smoke suppression
- Sintering between inorganic filler particles
- Anti-tracking and anti-arcing
- Dripping prevention

In halogen containing systems, zinc borates are synergist of halogen sources. They can function both as a smoke suppressant and as an afterglow suppressant. And, studies show that they can also improve thermal stability and provide anti-tracking and anti-arcing properties. In addition, zinc borates:

- Release water to provide additional flame retardancy
- Provide corrosion resistance

### Lower cost alternative to antimony oxide

The lower cost *Firebrake* zinc borates can partially or completely replace more expensive antimony oxide in many flame retardant formulations—resulting in better flame retardancy and lower smoke.

### Versatility across polymer types

Zinc borates are used in a wide range of polymers:

- Polyvinyl chloride (PVC)
- Polyamide (nylon)
- Polyolefin
- Epoxy
- Acrylics
- Phenolics
- Silicones
- Polyether sulfones
- Various elastomers

## Why U.S. Borax *Firebrake* ZB and *Firebrake* 500?

### Consistency, quality, and reliability

The borate raw materials used in our *Firebrake* products comes from our world-class mine in Boron, California. Our refining process results in the high-quality, dependable products you've come to expect from U.S. Borax.

- Consistent round particle shape, bulk density, and particle size distribution
- Produced from refined zinc oxide and boric acid to reduce impurity levels
- Supply reliability: Our extensive distribution network ensures a regular supply to meet your needs

### Technical expertise

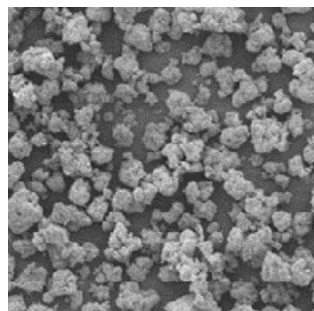
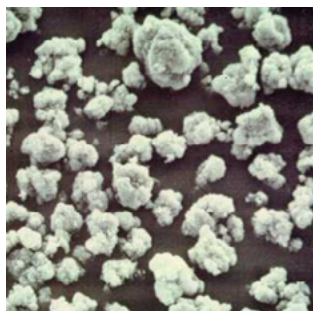
We have decades of institutional knowledge about the use of zinc borates in polymers. In fact, we pioneered the use of zinc borates as fire retardants. And, we have a global, multi-lingual technical support team can provide advice on formulation and process troubleshooting.

# BROCHURE: FIREBRAKE FOR POLYMER FIRE RETARDANCY

Attribute	<i>Firebrake ZB and Firebrake 500</i>	Certain other zinc borates
Impurities	<p>Product tests consistently result in tight specifications and lower impurities levels due to:</p> <ul style="list-style-type: none"> <li>• Boric acid mined and refined in the United States</li> <li>• Only using high-quality zinc oxide</li> </ul>	<p>High impurity levels in some unrefined zinc borate products can lead to:</p> <ul style="list-style-type: none"> <li>• Lower flammability performance</li> <li>• Higher heavy metal levels such as lead—a concern in some applications</li> <li>• Corrosion in production with high sulfate and chloride content</li> <li>• Increase in ionic conductivity due to high chloride, sulfate, and sodium content which can be an issue for electrical/electronic applications</li> </ul>
Morphology	<p>Consistent crystal morphology over a 40 year period</p> <p>Round micro-crystalline agglomerates for consistent powder flow</p>	<p>Variation and inconsistencies in particle shape between and among other products may impact:</p> <ul style="list-style-type: none"> <li>• Flow in feeding process</li> <li>• Processing into polymer requiring higher energy use and poor particle distribution</li> </ul>
Thermal stability	<ul style="list-style-type: none"> <li>• <i>Firebrake ZB</i>: Thermally stable to 290°C</li> <li>• <i>Firebrake 500</i>: Thermally stable to 600°C</li> </ul>	<ul style="list-style-type: none"> <li>• May contain impurities that reduce thermal stability of the polymer</li> <li>• Hydrous zinc borates cannot be used for high processing temperature polymers</li> </ul>
Bulk density	High and consistent bulk density at 45–55 pcf allows for reliable feeding and processing	Low and inconsistent bulk density ranging from 15–40 pcf

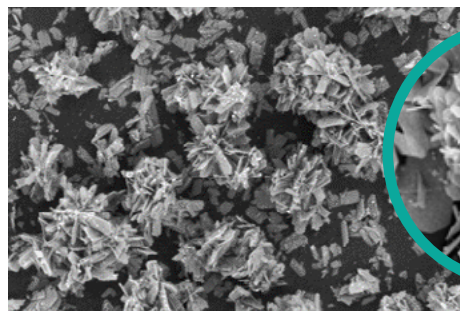
## *Firebrake ZB and Firebrake 500*

The more rounded particle shape of U.S. Borax *Firebrake* zinc borate products promotes consistent powder flow, process handling, and distribution in the product.



## Other zinc borate on the market

An example of zinc borate with a platy open particle structure. It could reduce powder flowability and bulk density—potentially affecting process handling and distribution.



## BROCHURE: FIREBRAKE FOR POLYMER FIRE RETARDANCY

	<i>Firebrake ZB</i>	<i>Firebrake ZB Fine</i>	<i>Firebrake ZB-XF</i>	<i>Firebrake 500</i>
Description	Granular zinc borate	Fine granular zinc borate	Extra fine granular zinc borate	Anhydrous zinc borate
Formula	$2\text{ZnO} \cdot 3\text{B}_2\text{O}_3 \cdot 3.5\text{H}_2\text{O}$	$2\text{ZnO} \cdot 3\text{B}_2\text{O}_3 \cdot 3.5\text{H}_2\text{O}$	$2\text{ZnO} \cdot 3\text{B}_2\text{O}_3 \cdot 3.5\text{H}_2\text{O}$	$2\text{ZnO} \cdot 3\text{B}_2\text{O}_3$
ZnO	37.7 - 38.7%	37.7 - 38.7%	37.7 - 38.7%	43.5 - 45.5%
B <sub>2</sub> O <sub>3</sub>	47.5 - 48.9%	47.5 - 48.9%	47.5 - 48.9%	53.5 - 55.5%
H <sub>2</sub> O	14%	14%	14%	--
Typical median particle size	9µm	2.3µm	1.8µm	9µm
Typical top size (Horiba)	--	--	12µm	--
Refractive index	1.58	1.58	1.58	1.58
Specific gravity	2.8	2.8	2.8	2.6
Solubility (wt%)	<0.28	<0.28	<0.28	--

- *Firebrake ZB Fine* and *Firebrake ZB-XF* are recommended for applications where maximum fire test performance is needed, and physical properties such as film forming and adhesion are critical.
- *Firebrake 500* is thermally stable up to 600° C and is used in high processing temperature polymers such as nylon 66 and polyethersulfone.

### 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.