Firebrake zinc borates for polymer fire retardancy

U.S. Borax's *Firebrake*® line of zinc borate products are unique zinc borates that combine the beneficial effects of zinc and boron oxides. They are multi-functional fire retardants for polymers, and can be used in applications such as construction products, electrical/electronics, transportation (aviation and mass transit), fabrics, and industrial coatings

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Why zinc borates?

Studies have shown 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. The refining process results in the high-quality, dependable products you've come to expect from U.S. Borax.

- Consistent round particle shape for potentially improved powder flow
- Consistent 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

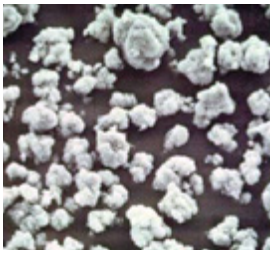
Technical expertise

U.S. Borax has decades of institutional knowledge about the use of zinc borates in polymers.

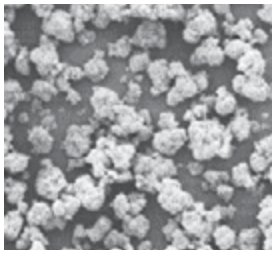
- We pioneered the use of zinc borates as fire retardants
- Our experts are advancing the science of zinc borates through continuing research
- A global, multi-lingual technical support team can provide advice on formulation and process troubleshooting

Attribute	*Firebrake* ZB and *Firebrake* 500	Certain other zinc borates
Impurities	Product tests consistently result in tight specifications and lower impurities levels due to: • Boric acid mined and refined in the United States • Only using high-quality zinc oxide	High impurity levels in some unrefined zinc borate products can lead to: • Lower flammability performance • Higher heavy metal levels such as lead—which can be a concern in some applications • Corrosion in production with high sulfate and chloride content • Increase in ionic conductivity due to high chloride, sulfate, and sodium content which can be an issue for electrical/electronic applications
Morphology	• Consistent crystal morphology over a 40 year period • Round micro-crystalline agglomerates for consistent powder flow	Variation and inconsistencies in particle shape between and among other products may impact: • Flow in feeding process • Processing into polymer requiring higher energy use and poor particle distribution
Thermal stability	• *Firebrake* ZB is thermally stable to 290°C • *Firebrake* 500 is thermally stable to 600°C	• May contain impurities that reduce thermal stability of the polymer • Hydrous zinc borates cannot be used for high processing temperature polymers
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

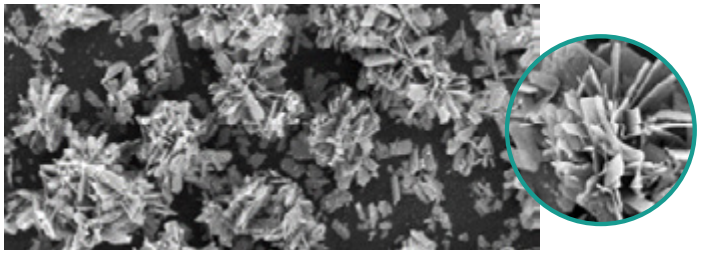


Firebrake 500



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.

	Firebrake ZB	*Firebrake* ZB Fine	*Firebrake* ZB-XF	*Firebrake* 500
Description	Granular zinc borate	Fine granular zinc borate	Extra fine granular zinc borate	Anhydrous zinc borate
Formula	$2ZnO{\cdot}3B_2O_3{\cdot}3.5H_2O$	$2ZnO{\cdot}3B_2O_3{\cdot}3.5H_2O$	$2ZnO{\cdot}3B_2O_3{\cdot}3.5H_2O$	$2ZnO{\cdot}3B_2O_3$
ZnO	37.7-38.7%	37.7-38.7%	37.7-38.7%	43.5 - 45.5%
B2O3	47.5-48.9%	47.5-48.9%	47.5-48.9%	53.5 - 55.5%
H2O	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.

Firebrake®

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 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