Application Leaflet

CHARGUARD™

Organoclay based fire retardant synergists for thermoplastic compounding applications.

ELEMENTIS

Unique chemistry, sustainable solutions

Contents

Key Benefits

- Smoke Suppression
- Enhances char formation
- Reduces drip and flame spread
- Fire-retardant performance booster
- Improved thermal stability
- No intentionally added fluorinated substances

Introducing CHARGUARD™

CHARGUARD™ is a family of versatile organoclay-based additives designed for polymer compounding.

CHARGUARD optimizes the performance of halogenated and non-haloganted flame retardants with a focus on ensuring fire safety compliance and maximizes the return on investment of the overall fire-retardant package.

FIGURE 1: Smectite clays

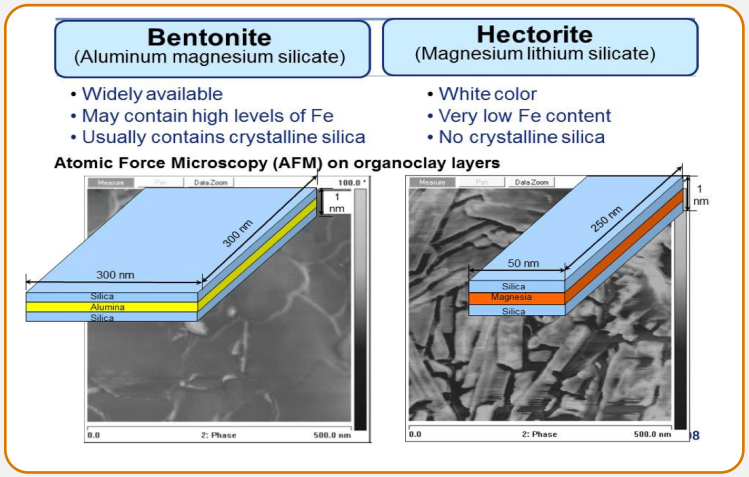


FIGURE 2: Organoclays

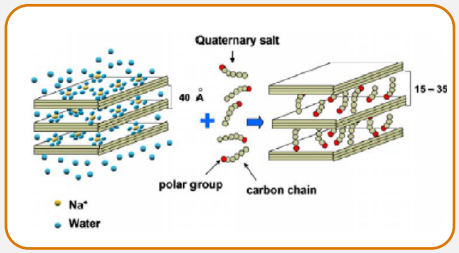
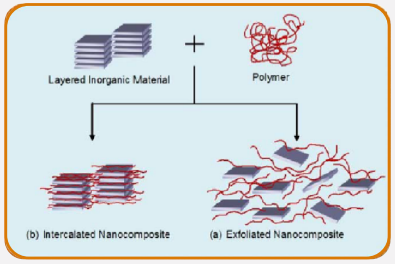


FIGURE 3: Barrier effect from stacked platelet structure within polymeric matrix (exfoliated and non-exfoliated)



How CHARGUARD™ works

CHARGUARD™ products are made from stacked platelet nanostructure clays. **FIGURE 1**. When treated with quaternary ammonium salts, these clays become organoclays. **FIGURE 2**.

Once in organoclay form, the stacked platelet structure creates a **barrier effect FIGURE 3**, inhibiting the release of flammable gases and heat within a polymeric matrix. In this way, CHARGUARD™ enhances the thermostability and structural reinforcement properties of melt-processed thermoplastics during compounding, injection molding, extrusion, or coating.

The **fine particle size distribution** and **high surface area** of organoclay structures allow for better interaction with the polymeric matrices. This further ensures thermostability and prevents heat aging and hotspots during processing.

Organoclays also enhance **char formation** on the polymer surface during combustion. This layer acts as an insulative thermal barrier, reducing exposure of the underlying material to the fire.

Where to use CHARGUARD™

CHARGUARD™ is compatible with most low-to-medium-polarity thermoplastics and fire retardants, including those made from:

- **Low-density polyethylene (LDPE)**
- **Polypropylene (PP)**
- **Ethylene vinyl acetate co-polymer (EVA)**
- **Polyamide (Nylon 6)**
- **High-impact polystyrene (HIPS)**
- **Polylactic acid (PLA)**

Choosing the right CHARGUARD™ product

To meet varying application and market needs, the CHARGUARD™ portfolio includes three products: CHARGUARD™ 2010, CHARGUARD™ 2000, and CHARGUARD™ 1000.

CHARGUARD™ 2010: Locally sourced synergist developed for China and APAC
CHARGUARD™ 2010 is made from a locally sourced bentonite clay and has a milky-white to light-grey color profile. As a non-exfoliated clay, it's ideal for compounding low-to-medium-polarity thermoplastics at temperatures below 220 C where effective char formation is desired.

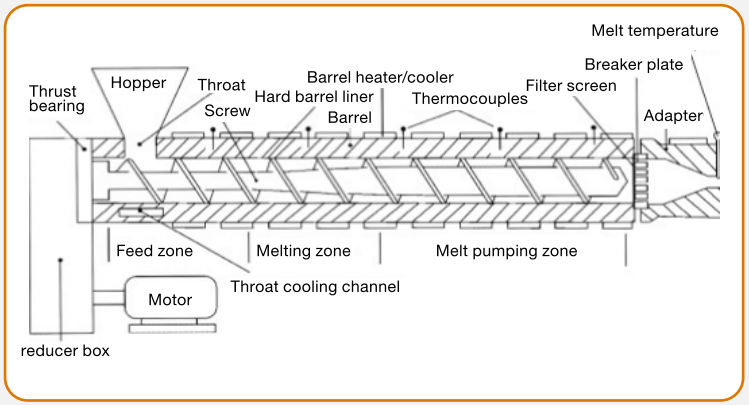
CHARGUARD™ 2000: For optimal fire safety in neutral-colored plastics
CHARGUARD™ 2000 is made with an exfoliated bentonite. This low-to-medium-polarity large platelet organoclay is designed for applications that require high tensile strength, exceptional elongation to break, and outstanding melt-flow retention properties. It's ideal for neutral-colored, opaque plastic compounding applications where color is less critical, but fire safety paramount.

CHARGUARD™ 1000: For consumer electronics and whiteware
Hectorite-based CHARGUARD™ 1000 is ideal for consumer electronics and whiteware that require a bright white finish, thanks to its natural white color and ultra-fine particles. With easy processing under high mechanical stress and an ultra-fine, delaminated platelet structure, it's ideal for formulations that require both improved fire safety and a polished appearance.

TABLE 1: CHARGUARD™ products at a glance

	CHARGUARD™ 2010	CHARGUARD™ 2000	CHARGUARD™ 1000
Organoclay type	Bentonite (aluminum magnesium silicate)	Bentonite (aluminum magnesium silicate)	Hectorite (magnesium lithium silicate)
Fe content	Contains higher levels	Contains higher levels	Contains lower levels
Exfoliated	Tactoidal agglomerate	Sheared platelet	Tactoidal agglomerate
Color profile	Milky white to light grey	Light tan	Light coral
Key properties	• Intermediate polarity •Unique, uniform lamellar silicate structure • Easy to process under mechanical stress	• Low to medium polarity • Provides high tensile strength, exceptional elongation to break, and ultra-low moisture pickup properties	• Intermediate polarity • Ultra-fine, platelet structure • Easy to process under mechanical stress
Typical applications	Neutral, opaque polymeric fire-retardant thermoplastic compounding.	Neutral, opaque fire-retardant thermoplastic compounding.	Opaque-to-clear fire-retardant thermoplastic compounding at or below 250C, where a bright, light-colored finish is needed.

FIGURE 4: CHARGUARD™ application diagram



How to incorporate CHARGUARD™

TABLE 2: CHARGUARD™ application recommendations

	Recommendation	
Application rate	3%-5% based on total formulation weight	
Application method	• Premix with fire retardant • Introduce at extruder throat for maximum mixing • Extended-duration zonal processing temperatures >200°C will cause thermal oxidation and off-gassing, resulting in an acrid smell and polymer discoloration during processing. Consult wtih Elementis technical representative for more details	
Dispersion tool	• Co-rotating twin-screw extruder or BUSS continuous kneader • Longest twin screw configuration possible (>40 Length / 1 Diameter) with opposing screw geometry under high dispersion force	
Possible additives	*Coupling agents* To improve the adhesion of CHARGUARD™ to the polymer matrix, potential coupling agents include: • Dow Fusabond MB100 • Evonik Dynasylam® AMEO • BRB International Silanil 919	*Antioxidants* To provide stability during high-temperature processing, and enhance the performance of both polymer and organoclay, antioxidants such as Irganox 1010 are recommended.

Measuring the performance of CHARGUARD™

Fire retardance performance

When incorporated into the starting formulations shown in **TABLE 3** and tested for flammability according to the UL 94 standard, CHARGUARD™ demonstrated strong performance as a fire retardant. Results are shown in **TABLE 4**.

TABLE 3: Starting formulations

	Desc.	DOW DFDA-7530 Nat.	Elvax 470	Compoline CO/LL	MG-Guard-AO-1010	Apyral 40 CD V2 (FR)	Elementis CHAR-2010	Elementis CHAR-2000	Elementis CHAR-1000
1	FR with CHARGUARD 2010	12.25	16.00	5.00	1.75	61.25	3.75		
2	2.5% less FR with CHARGUARD 2010	13.18	17.21	5.38	1.88	58.75	3.60		
3	5% less FR with CHARGUARD 2010	14.11	18.43	5.76	2.02	56.25	3.44		
	FR with CHARGUARD 2000 (prior trial)	12.25	16.00	5.00	1.75	61.25		3.75	
4	2.5% less FR with CHARGUARD 2000	13.18	17.21	5.38	1.88	58.75		3.60	
5	5% less FR with CHARGUARD 2000	14.11	18.43	5.76	2.02	56.25		3.44	
	FR with CHARGUARD 1000 (prior trial)	12.25	16.00	5.00	1.75	61.25			3.75
6	2.5% less FR with CHARGUARD 1000	13.18	17.21	5.38	1.88	58.75			3.60
7	5% less FR with CHARGUARD 1000	14.11	18.43	5.76	2.02	56.25			3.44
X	control no FRS (prior trial)	12.73	16.62	5.19	1.82	63.64			

TABLE 4: UL 94 Fire Retardant (FR) test results

	Sample	UL 94
	FR with CHARGUARD™ 2010	V-0
1	2.5% less FR with CHARGUARD™ 2010	V-1
2	5% less FR with CHARGUARD™ 2010	V-1
	FR with CHARGUARD™ 2010	V-0
4	2.5% less FR with CHARGUARD™ 2000	V-0
5	5% less FR with CHARGUARD™ 2000	V-0
	FR with CHARGUARD™ 1000	V-0
6	2.5% less FR with CHARGUARD™ 1000	V-0
7	5% less FR with CHARGUARD™ 1000	V-1
X	Control: no fire-retardant synergist (prior trial)	V-0

Synergist performance

In addition, the formulations incorporating CHARGUARD™ demonstrated strong thermal stability, tensile strength, and tensile modulus: key indicators of synergist performance.

FIGURE 5: TGA comparison for CHARGUARD™ 2010, 1000, and 2000

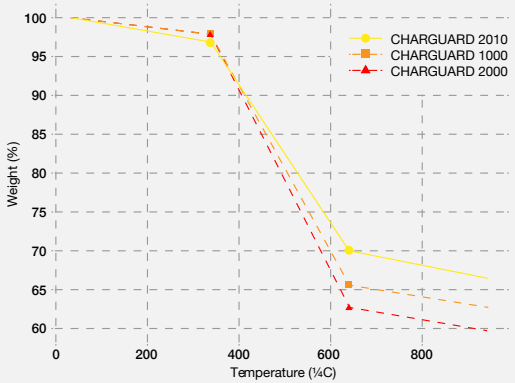


FIGURE 6: Tensile elongation data (break) via ASTM D412

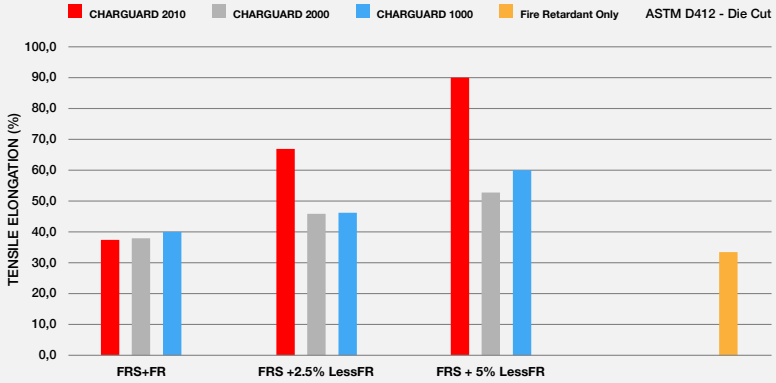
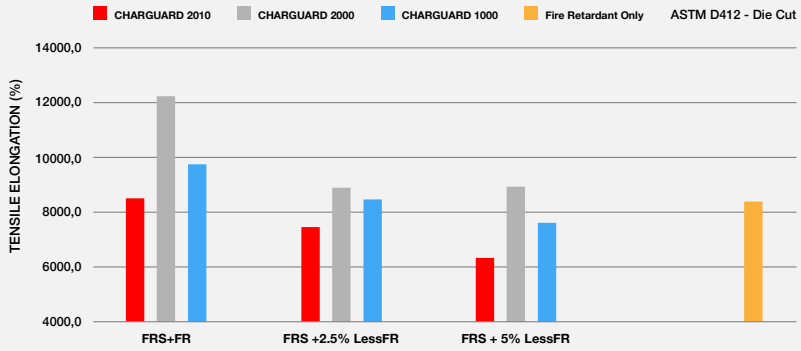


FIGURE 7: Tensile modulus data (PSI) via ASTM D412



Thermal stability

Thermogravimetric analysis (TGA) measures a material's weight loss as a function of increasing temperature, providing insight into its thermal stability. **FIGURE 5** shows the TGA profiles of each CHARGUARD™ product, all of which demonstrate good thermal stability. CHARGUARD™ 2000 exhibits the highest thermal degradation, losing around 35.09% of its weight at around 267.87°C. CHARGUARD™ 1000 undergoes slightly lower weight loss (~32.42%) and degrades at a higher temperature (~322.70°C). CHARGUARD™ 2010 exhibits the lowest weight loss (~30.10%) but starts degrading at the lowest temperature (~231.57°C).

Tensile strength

Tensile strength is the maximum tensile stress beyond which a material fails and breaks. Adding 3.5% CHARGUARD™ by weight increased tensile elongation values by 50% in the LLDPE/EVA-based wire and cable compound tested **FIGURE 6.**

Tensile modulus

Tensile modulus is the ratio of stress to elastic strain in tension. A high tensile modulus means that the material is rigid, so more stress is required to produce a given amount of strain. **FIGURE 7** shows that adding 3.5% CHARGUARD™ by weight increased tensile modulus (PSI) by as much as 50% in the LLDPE/EVA wire and cable compound tested.

To find out more about CHARGUARD™, visit https://www.elementis.com/markets-and-products/plastics/charguardtm-1000-and-charguardtm-2000-1/ or contact us directly.

NOTE:

The information herein is currently believed to be accurate. We do not guarantee its accuracy. Purchasers shall not rely on statements herein when purchasing any products. Purchasers should make their own investigations to determine if such products are suitable for a particular use. The products discussed are sold without warranty, express or implied, including a warranty of merchantability and fitness for use. Purchasers will be subject to a separate agreement which will not incorporate this document.

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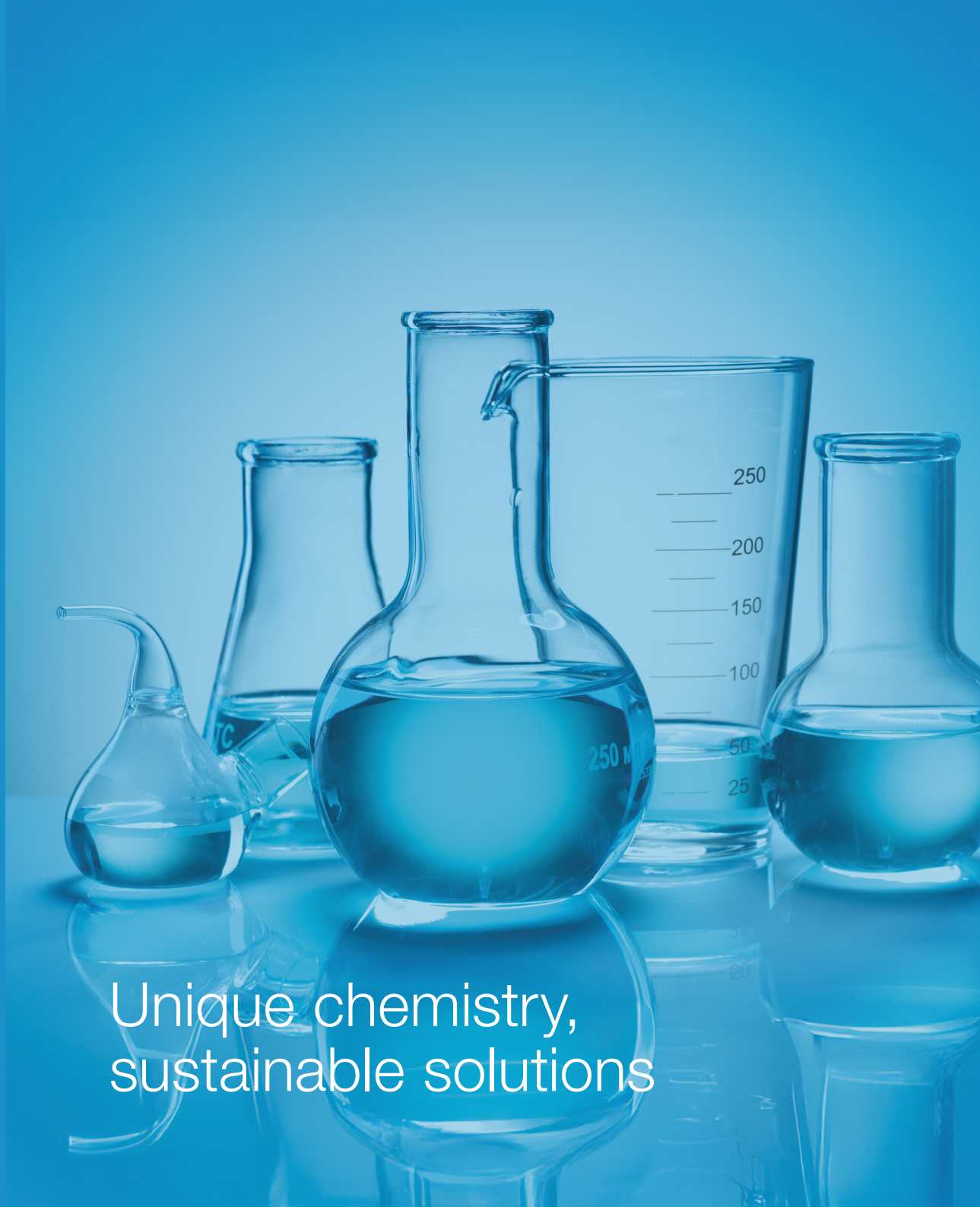

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