Application Leaflet

CHARGUARD™

Organoclay-based fire-retardant synergists for thermoplastic compounding applications

Unique chemistry, sustainable solutions

Key Benefits

- Low Environmental Impact
- Synergistic Effect with Fire Retardant
- Drip and flame spread reduction
- Enhances char formation
- Suppresses smoke
- Improved thermal stability

Introduction

CHARGUARD™ is a versatile family of organoclay-based specialty additives for polymeric compounding applications. They enhance the performance of both halogenated and non-halogenated flame retardants such as aluminum trihydrate (ATH) and magnesium hydroxide (MTH). CHARGUARD™ improves the effectiveness of fire retardants and the behavior of plastic components, while ensuring compliance with stringent fire safety standards. CHARGUARD™ unlocks the maximum performance potential and return on investment of your fire-retardant package in plastic compounding applications, while being free of intentionally added fluorinated substances.

Features

- **Nanostructure formation:** CHARGUARD™ has layered nanostructures that enhance the thermostability and structural reinforcement properties of melt-processed thermoplastics that are compounded, injection molded, extruded, or coated.
- **Wide Compatibility:** CHARGUARD™ has compatibility most low to medium polarity thermoplastics and fire retardants.
- **Surface modification:** the high surface area of CHARGUARD™ allows for better interaction with polymer matrices.
- **Dispersion:** CHARGUARD™ helps to prevent unnecessary heat aging of the polymer matrix during processing. The fine particle size distribution of CHARGUARD ensures uniform thermal stability and prevents hotspots within the polymer matrix from occurring.
- **Thermal Decomposition:** During combustion, CHARGUARD™ forms a char layer on the polymer surface when exposed to fire, acting as an insulative thermal barrier, thus reducing the exposure of the underlying material to the fire.
- **Environmentally friendly:** CHARGUARD™ does not contain intentionally added fluorinated substances and can be used to replace PTFE type synergists.

Suitable Resin Systems

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

Incorporation and levels of use

CHARGUARD™ is most effectively used when dispersed with a co-rotating twin-screw extruder or a BUSS continuous kneader. We recommend using CHARGUARD™ at a rate of 3% to 5% based on total formulation weight.

When compounding with CHARGUARD™ it is recommended to use the longest twin screw configuration possible (>40 Length / 1 Diameter) with an opposing screw geometry under high dispersion force.

Ideally, CHARGUARD™ should be premixed with the fire retardant and introduced at the extruder throat to ensure maximum mixing. Extended duration zonal processing temperatures exceeding 200°C will cause thermal oxidation and off-gassing resulting in an acrid smell and polymer discoloration during processing.

Coupling agents for thermoplastic compounding including Dow Fusabond MB100, Evonik Dynasylan® AMEO, and BRB International Silanil 919 improve CHARGUARD™ organoclay adhesion with the polymer matrix.

Antioxidants provide stability during the high-temperature processing of plastics, ensuring that the organoclay properties are not compromised. They inhibit the oxidation of both the polymer and the organoclay, preserving the performance characteristics of the composite material. By maintaining the stability and integrity of the material, antioxidants help achieve the desired improvements in mechanical and physical properties provided by the organoclays. Antioxidants such as MG Guard AO-1010 are recommended for use with polyolefins.

FIGURE 1: Smectite clays

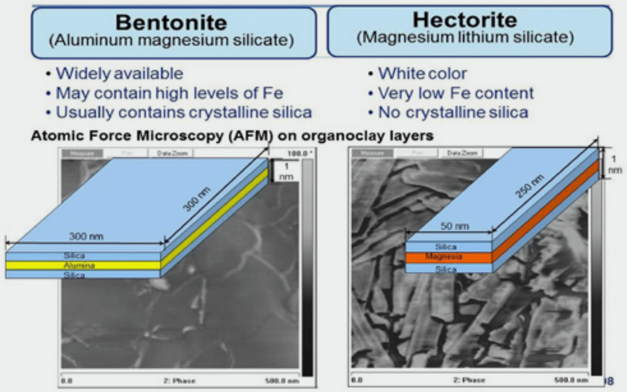


FIGURE 2: Organoclays

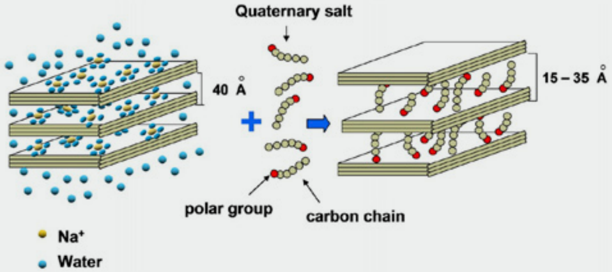


TABLE 1: UL 94 Test Results

Run	Fire Retardant (FR) Testing	UL-94 Results
1	2.5% less FR with CHARGUARD™ 2000	V-0
2	5% less FR with CHARGUARD™ 2000	V-0
3	2.5% less FR with CHARGUARD™ 1000	V-0
4	5% less FR with CHARGUARD™ 1000	V-1
X	Fire Retardant without Synergist	V-0

Products tested

Part 1: Bentonite vs. Hectorite

FIGURE 1: Bentonite and hectorite are types of smectite clay that have a stacked platelet structure. When converted into organoclays, their stacked platelet structure allows them to create a barrier effect, thus inhibiting the release of flammable gases within a polymeric matrix.

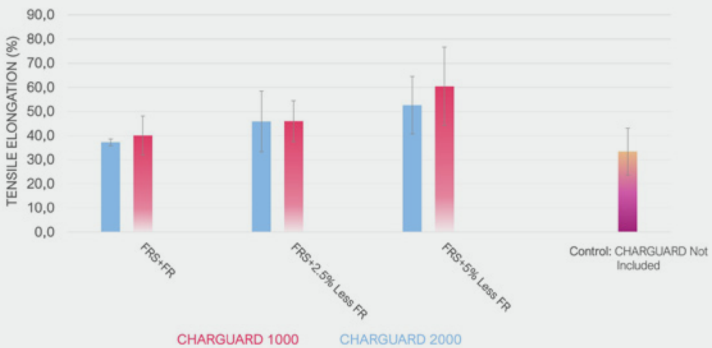
FIGURE 2: The clays treated with quaternary salts develop the ability to swell by adsorption of organic molecules, resulting in the organoclay. Organoclays improve thermal stability and reduce the rate at which heat is released in polymer matrices. They also enhance char formation during combustion.

TABLE 2: Starting Point Formulation

#	Desc.	DOW DFDA-7530 Nat.	Elvax 470	Compoline CO/LL	MG-Guard-AO-1010	Apyral 40 CD V2 (FR)	Elementis CHARGUARD™ 2000	Elementis CHARGUARD™ 1000
1	2.5% less with CHARGUARD 2000	13.18	17.21	5.38	1.88	58.75	3.60	
2	5% less FR with CHARGUARD 2000	14.11	18.43	5.76	2.02	56.25	3.44	
3	2.5% less FR with CHARGUARD 1000	13.18	17.21	5.38	1.88	58.75		3.60
4	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		

FIGURE 3: Melt flow index via ASTM 1238 (210C / 2.16kg.)

FIGURE 4: Tensile elongation data (break) via ASTM D412



Organoclay Synergist Performance

The Melt Flow Index (MFI) measures the ease of flow of the melt of a thermoplastic polymer. **FIGURE 3** shows that by adding 3.5% by weight of CHARGUARD™, the melt flow index of an LLDPE/EVA wire and cable compound is reduced by +100%. A similar melt flow index can be achieved in the same formulation by removing 7% of the fire retardant.

Tensile strength is the maximum tensile stress beyond which a material fails and breaks. With a total addition of 3.5% CHARGUARD™ by weight, tensile elongation values increased by 50% in the LLDPE/EVA-based wire and cable compound tested (**FIGURE 4**).

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 5** shows that an addition of 3.5% of CHARGUARD™ by weight increased the tensile modulus (PSI) of the LLDPE/EVA wire and cable compound tested by as much as 50%.

FIGURE 5: Tensile modulus (PSI) via ASTM D412

NOTE:
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