MAGRIStalc

Flame Retardancy Solutions with Magris Talc

Flame Retardancy Solutions for Polyamide 6

MAGRIStalc

Introduction

Intumescent flame retarded (FR) Engineering Thermoplastics (ETP) are increasingly used in electrical and electronic (E&E) applications, covering a broad range of products from cellular phones and computers to washing machines and other appliances.

They utilize FR components, such as phosphorous based materials, that promote the formation of a porous/foamed char phase during combustion, which creates a barrier to the transfer of heat, combustibles and oxygen to slow down and eventually extinguish the flame. Magris Talc products are naturally non-combustible materials that remain in the solid/char phase when used in ETP formulations; they contribute to the formation, strengthening and flame retardancy of intumescent char.

This bulletin focuses on the specific benefits of Magris Talc products in common intumescent FR formulations of glass-fiber reinforced Polyamide 6 to show how specifically HYPERPLATE® Talc is used to partially replace glass fiber, while improving flame retardancy and polymer processing of the formulations.

Magris Talc Products

Magris Talc offers a broad range of talc products globally from our mines in the United States and Canada. Talc has a neutral platy morphology with a strong tendency for delamination during processing, which makes it a suitable reinforcing mineral for polymers including ETP. Talc is also known as the most efficient mineral nucleating agent for semi-crystalline polymers.

HYPERPLATE® Talc products belong to a patented family of products offering the highest talc aspect ratios due to their proprietary delaminating milling process.

Intumescent FR Study in Glass Fiber Filled PA6

A study was conducted to evaluate the potentials of HYPERPLATE® for use in a glass fiber reinforced intumescent FR formulation of PA6. An organic phosphonate based FR additive (Exolit OP 1314 from Clariant) was used in the study along with a chopped glass fiber (GF) additive sized for polyamide formulations (EC 10-675, 4mm from Johns Manville).

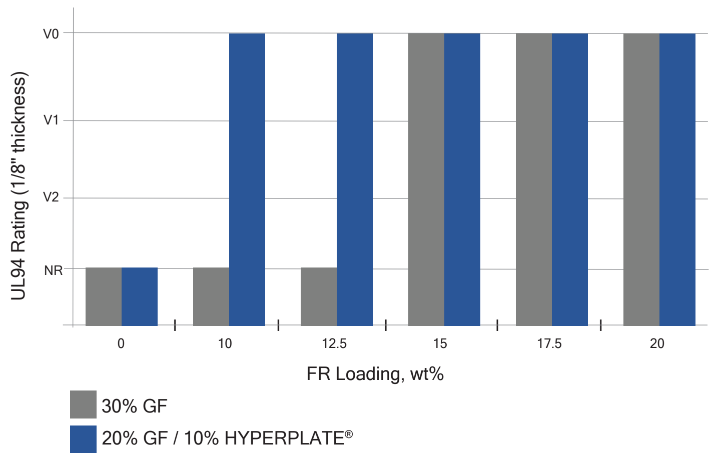
FR Performance

UL94 FR test is the typical flame retardant standard used for these types of PA6 formulations that are used in E&E applications. Normally, the performance target is to achieve the best rating that is UL94-V0.

FR results obtained in this study show that partial replacement of glass fiber with HYPERPLATE® Talc can improve FR performance.

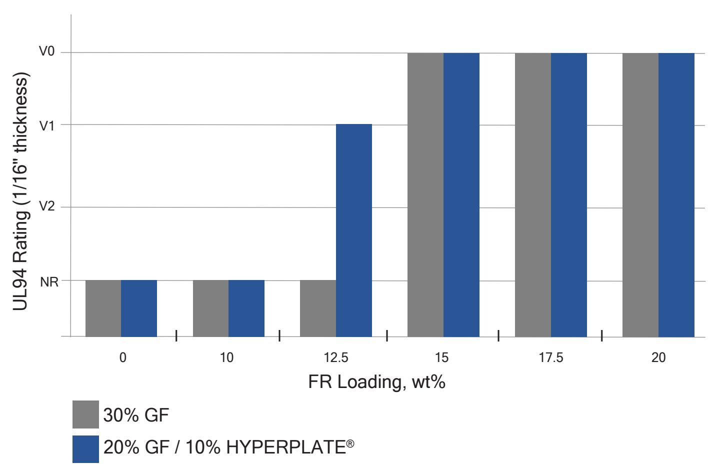
HYPERPLATE® Talc can be used to reduce the loading level of Exolit OP 1314 and replace 10% of glass fiber while maintaining V0 rating in UL94 FR test at 1/8" (**Fig. A**) or 1/16" (**Fig. B**) specimen thickness. At 1/32" (**Fig. C**) thickness, they outperform the incumbent 30% GF-filled formulation by meeting UL94-V1 rating at 15% FR loading.

Fig. A UL94 Test Ratings for 1/8" Specimen Thickness



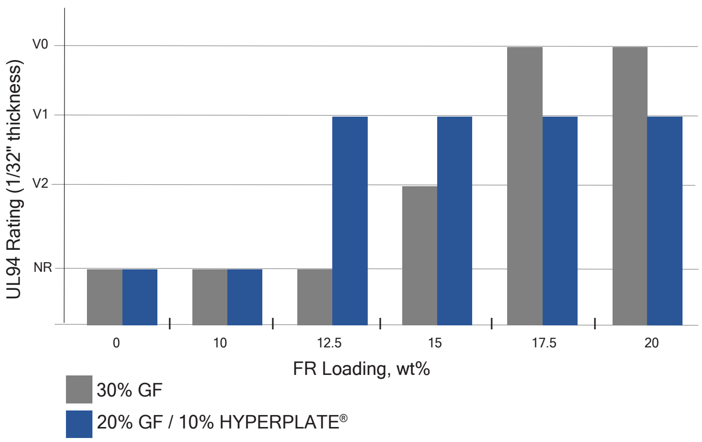
At 1/8" thickness: Formulations with 10% HYPERPLATE® Talc loading achieve UL94-V0 rating to outperform the incumbent (30% GF in FR PA6) that requires 15% FR loading (5% savings).

Fig. B UL94 Test Ratings for 1/16" Specimen Thickness



At 1/16" thickness: Formulations with 10% HYPERPLATE® Talc loading achieve UL94-V0 rating to outperform the incumbent (30% GF in FR PA6) that requires 15% FR loading (5% savings).

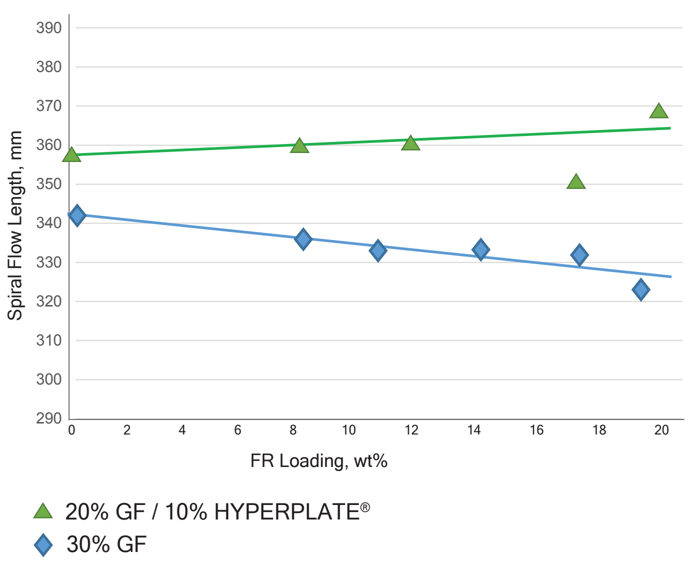
Fig. C UL94 Test Ratings for 1/32" Specimen Thickness



At 1/32" thickness: Formulations with 10% HYPERPLATE® Talc replacement outperform the incumbent formulation by achieving UL94-V1 rating at 15% (or lower) FR loading.

Polymer Processing - Rheology

Replacing 10% of glass fiber with HYPERPLATE® improved the rheology/flow of the compound as shown in the spiral mold flow length measurements below in **Fig. D**.



Conclusions

Partial replacement of glass fiber with HYPERPLATE® Talc improves FR performance.

HYPERPLATE® Talc can be used to reduce the loading level of Exolit OP 1314 and replace 10% of glass fiber while maintaining V0 rating in UL94 FR test at 1/8" or 1/16" specimen thickness. At 1/32" thickness, HYPERPLATE® Talc outperforms the incumbent 30% GF-filled formulation by meeting UL94-V1 rating at 15% FR loading.

Experimental Procedure

Materials used:
PA6: Ultramide B27E (BASF)
Glass Fiber: EC10-675, 4mm (Johns Manville)
Intumescent FR: Exolit OP 1314 (Clariant)

Compounding:
Berstoff ZE 25A x 46D, 250 rpm, 15kg/hr
FR additive feedport: Extruder throat
HYPERPLATE® feedport: Sidefeeder at Barrel Zone 3
GF feedport: downstream at Barrel Zone 5
Drying PA6 to < 0.4% moisture

Injection Molding:
Arburg Allrounder 370E 600-170 IM press
Drying the compound to < 0.2% moisture
ISO and UL94 standard specimen molds
Spiral-flow mold

Testing:
FR: UL94 conducted on 1/8", 1/16" and 1/32" thick specimens (UL Certified Lab)

Flame Retardancy Solutions for EVA

Introduction

Plastics used in electrical applications need to reduce the risk of flame in the event of exposure to an external source of ignition or an electrical fault. The material must resist combustion as long as possible.

We studied formulation in which EVA had been filled with MDH, our Mistron® HYPERPLATE® (high lamellarity grade of talc produced using Magris Talc proprietary delamination technology) and three other talcs with different specific surface areas (SA), particle size distributions and lamellarity indices.

To determine the lamellarity of the different talcs, the median diameters were measured by laser diffraction and Sedigraph® particle size distribution. The lamellarity index (LI) calculated from these values (LI = D50 Laser - D50 Sedimentation/D50 Sedimentation) gives a quantitative indication of the platyness of the particles.

Intumnescent FR Study with High Lamellarity Mistron® HYPERPLATE®

Characteristics of Mistron® HYPERPLATE® (T4* below) and 3 Other Talc Products.

Talc	SA-BET (m^2g^{-1})	D50 Sedigraph® (µm)	D50 Laser (µm)	LI
T1	9	5.7	11	0.94
T2	11	3.1	5.2	0.67
T3	15	2.5	7.9	2.20
T4*	33	1.2	4.7	2.82

The LOI values of EVA filled with 60% MDH was compared to LOI values obtained for EVA/45%-MDH/15%-talc, per table below. All formulations listed performed similarly with no dripping observed.

Talc	Formulations (wt%)	LOI (%)
	EVA + 60% MDH	49
T1	EVA + 45% MDH + 15%	46
T2	EVA + 45% MDH + 15%	46
T3	EVA + 45% MDH + 15%	48
T4*	EVA + 45% MDH + 15%	46

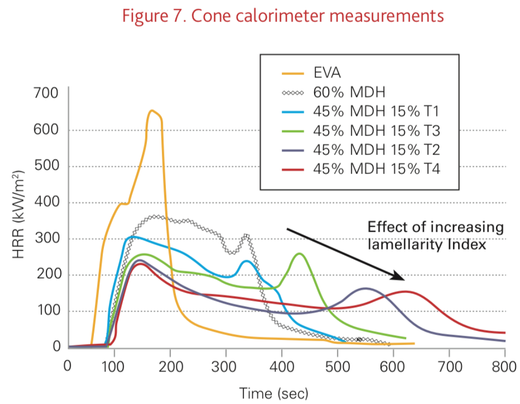
Cone colorimeter (**Fig.1**) experiments were conducted on these formulations according to ISO 5660. For the EVA/MDH sample not containing talc, a much lower Heat Release Rate (HRR) value was obtained and combustion time was longer than the pure EVA compound. Although a protective crust formed, significantly reducing the HRR, it broke up quickly as combustion continued.

Slightly different behavior was observed when MDH was partially substituted by talcs with low surface areas and low lamellarity indices. Maximum HRR decreased and combustion time increased, while the rigid crust formed was modified to form a thick foam.

This foaming behavior is more pronounced with our Magris Talc, Mistron® HYPERPLATE® (T4*). The sample started to swell as soon as it was irradiated, with material thickness increasing to twice its original thickness before ignition.

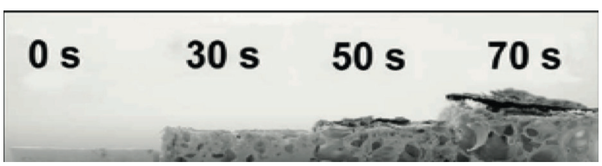
After complete combustion, an inorganic, foamed, rigid char remained. Maximum HRR was significantly reduced compared to the EVA/MDH compound. The HRR peak decreased as the lamellarity index increased.

Fig. 1 Cone Calorimeter Measurements



To illustrate the formation of this foamed structure, cone calorimeter experiments were carried out with different samples containing Magris Talc Mistron® HYPERPLATE® (T4*), stopping irradiation at different times (**Fig. 2**) from 0 to the time of ignition (~70s).

Fig. 2 Cone Calorimeter Measurements



The foaming process clearly takes place during the pre-ignition phase. Note that all the samples were still flexible and cohesive after the experiment.

It is postulated that this intumescent phenomenon combines heterogeneous bubble nucleation, increased viscosity, barrier effect and char promotion. The higher viscosity, caused by the presence of lamellar particles, results in increased bubble nucleation, reduced speed of growth and a more cohesive structure.

Conclusions

Talc can be used as a partial replacement for MDH and ATH in EVA compounds for flame retardant applications, reducing compound costs. It creates a mass transfer barrier and imparts a cohesive foam structure to the polymer.

For more stringent requirements, Magris Talc Mistron® HYPERPLATE® provides an outstanding intumescent effect which retards flame ignition and protects the EVA from combustion. This intumescence is mainly due to the conjunction of heterogeneous bubble nucleation, barrier effect, increased viscosity and char promotion.

Products

Canada Sourced Products	Applications	Median Particle Size Sedigraph µ	Top Size Hegman	Y Brightness
JetWhite® 3CW	Interior & Exterior TPO	1.3	7.5 (~6.25 microns)	91
JetFil® 3CC	Improved Scratch - TPO/PP	0.9	7.5 (~6.25 microns)	88
JetFil® 700C	Exterior TPO	1.5	7.0 (~12.5 microns)	88
JetFil® 625C	Exterior TPO	2.2	6.5 (~18.75 microns)	88
JetFil® 575P / JetFil® 575C	General PP & PVC Applications	3.4	5.75 (~28.13 microns)	87
JetFil® 575C-HB	Color Sensitive Applications	3.0	5.75 (~28.13 microns)	89
JetFil® P500	Appliances	4.5	5.0 (~37.5 microns)	85
JetFil® P350	General Purpose	7.5	4.25 (~46.88 microns)	84
JetFil® P200	General Purpose	8.5	2.0 (~75.0 microns)	83
JetFil® T590	Packaging, UTH*	4.5	5.0 (~37.5 microns)	83
JetFil® T490	Packaging, UTH*	5.5	4.5 (~43.75 microns)	81
JetFil® T390	Under the hood (UTH)	7.5	4.25 (~46.88 microns)	81
JetFil® T290	UTH*, WPC**	8.5	3.0 (~62.5 microns)	78

Houston Production Grades	Applications	Median Particle Size Sedigraph µ	Top Size Hegman	Y Brightness
JetWhite® 1H/HC Series	Nucleation	1.1	7.5 (~6.25 microns)	90
JetWhite® 7H/HC Series	Nucleation	1.9	7.0 (~12.5 microns)	91
JetWhite® 6H/HC Series	Nucleation	2.4	6.0 (~25.0 microns)	91
JetWhite® 4H Series	General Purpose	5.7	4.0 (~50.0 microns)	90
JetWhite® 2H Series	General Purpose	11	2.0 (~75.0 microns)	87
JetWhite® R7	PC/ABS	1.8	7.0 (~12.5 microns)	91***
Cimpact® 710HS	TPO - Odor Sensitive/Heat Aging	1.8	7.0 (~12.5 microns)	93***
Cimpact® 710C / 710D	Interior TPO	1.8	7.0 (~12.5 microns)	93***
Cimpact® 650C / 650D	Exterior TPO	2.2	6.5 (~18.75 microns)	92***
Cimpact® 610C / 610D	Exterior TPO	3.2	6.0 (~25.0 microns)	91***
Cimpact® 550C / 550D	Appliances	3.4	5.75 (~28.13 microns)	88***
JetWhite® 3CH	Interior and Exterior TPO	1.2	7.5 (~6.25 microns)	94
JetFil® 3CHE	Exterior TPO	1.2	7.5 (~6.25 microns)	82
JetFil® T1H	Exterior TPO	1.8	7.0 (~12.5 microns)	80
JetFil® T1HB	Interior TPO	1.8	7.0 (~12.5 microns)	89
Mistroblock® 1H/1HT/1HTC Series	Antiblock	1.1	7.5 (~6.25 microns)	91
Mistroblock® 7H/7HT/7HTC Series	Antiblock	1.9	7.0 (~12.5 microns)	91
Mistroblock® 6H/6HT/6HTC Series	Antiblock	2.4	6.0 (~25.0 microns)	91
Mistroblock® H/HT/HTC Series	Antiblock	3.5	5.75 (~28.13 microns)	90
Stellar® 510	Appliances	5	5.5 (~31.5 microns)	88***
Stellar® 420	Appliances	12	4.0 (~50.0 microns)	87***
JetWhite® 8230	Appliances	10	4.0 (~50.0 microns)	92***
JetFil® H590	Packaging, UTH*	5	5.5 (~31.5 microns)	77
JetFil® H390	UTH*, WPC**	8.5	4.5 (~43.75 microns)	74

** Under the hood*

*** Wood Plastic Composites*

**** Brightness measurements in GEB*

Products

Montana Sourced Products	Applications	Median Particle Size Sedigraph µ	Top Size Hegman	Y Brightness
JetFil® M625C	Exterior TPO	1.3	6.5 (~18.75 microns)	87***
Nicron® 674 DT2 / Nicron® 674C	Exterior TPO, Polyamides	1.9	7.0 (~12.5 microns)	87***
JetFil® M700 / JetFil® M700C	Exterior TPO	1.9	7.0 (~12.5 microns)	83
JetFil® M600 / JetFil® M600C	Exterior TPO	2.3	6.0 (~25.0 microns)	83
JetFil® M550 / JetFil® M550C	Exterior TPO/Appliances	2.2	5.5 (~31.5 microns)	83
JetFil® M500	Appliances	3.2	5.0 (~37.5 microns)	81
JetFil® M400	General Purpose, PVC	4.7	4.0 (~50.0 microns)	81
JetFil® M300	General Purpose	7.5	3.0 (~62.5 microns)	79
JetFil® M200	WPC	10	2.0 (~75.0 microns)	78
Nicron® 665	Nucleation	1.2	6.5 (~18.75 microns)	87***
Mistron® ZSC	Foam Nucleation	2	6.0 (~25.0 microns)	87***
MistroFoam™	Foam Nucleation	2.2	5.5 (~31.5 microns)	82
Nicron® 604	PVC Sheet, Antiblock	2.3	6.0 (~25.0 microns)	85***
Mistron® NT / Mistron® NTC	Antiblock	3.5	5.75 (~28.13 microns)	85
Mistron® 400C / 400CT	Antiblock	4	5.5 (~31.5 microns)	88
Silverline® 002	WPC**	9	3.0 (~62.5 microns)	78***
Silverline® 303	WPC**	6.1	3.0 (~62.5 microns)	78***

Vermont Sourced Products	Applications	Median Particle Size Sedigraph µ	Top Size Hegman	Y Brightness
JetFil® V625C	Exterior TPO	2.2	6.25 (~21.88 microns)	84
JetFil® V575C	General PP, PVC	3.3	5.0 (~37.5 microns)	82
JetFil® V390	UTH*, WPC**	8.5	4.0 (~50.0 microns)	77***

Specialty, High Aspect Ratio Grades	Applications	Median Particle Size Sedigraph µ	Top Size Hegman	GEB Brightness
HYPERPLATE® T77	Exterior TPO, Polyamides, FR†	2	5.25 (~34.63 microns)	79
HYPERPLATE® H92	Exterior TPO, Color Sensitive, Polyamides, FR†	2	5.25 (~34.63 microns)	92
Mistron® HYPERPLATE®	Exterior TPO, Polyamides, FR,†	1.1	6.5 (~18.75 microns)	80

** Under the hood*

*** Wood Plastic Composites*

**** Brightness measurements in GEB*

† *Flame Retardancy*

About Magris Talc

Magris Talc is one of the world's leading talc producers, supplying around 15 percent of world demand from our mines and processing plants in Canada and the United States. We are the acknowledged leaders in product quality, supply reliability and technical support – the services that create value for our customers and set us apart from competitors. With over a hundred years' experience in the extraction and processing of talc, we offer the highest quality talc products on the market today.

About Talc

Talc is a surprisingly versatile, functional mineral which possesses a unique combination of properties. Talc is soft, water repellent, chemically inert and highly platy and has a marked affinity for certain organic chemicals. Our industry experts have harnessed these properties to bring customers improved performance in a wide range of applications such as paper, paints, plastics, rubber, ceramics, agriculture, food and pharmaceuticals.

Meeting Today's Needs. Securing Tomorrow's.

We believe that running a successful business and sustaining quality of life and the environment go hand in hand. From implementing behavior-based safety training to rehabilitating the land, we think it's important that future generations' needs are not compromised by our actions today.

Our Fundamental Sustainability Principles are:

Safety – We promote the health and safety of employees, contractors, customers, neighbors and consumers through active caring.

Partnership – We seek to understand the issues that are important to our neighbors, and to make a lasting contribution to the communities in which we operate.

Environmental Protection – We work to minimize our environmental footprint by using natural resources efficiently, preventing pollution, complying with applicable laws and regulations and continually improving our performance.

Accountability – We conduct business in an accountable and transparent manner, relying on external auditing and reporting to understand and reflect our stakeholders' interests.

Magris Talc
www.magristalc.com
For more information, contact our team at sales@magristalc.com
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