TECHNICAL UPDATE

CRAY VALLEY
Hydrocarbon Specialty Chemicals

Use of Functionalized Polybutadienes in Aluminum Trihydrate (ATH) Filled Ethylene Vinyl Acetate (EVA) Compounds

Benefits

- Improved dispersion
- Increased ductility
- Enhanced flame retardancy

Target Markets

- Wire and cable

Additional Information

MSDS/TDS: Ricon 131 MA5

Description

Due to regulatory influences, industry is moving toward usage of non-halogenated mineral flame retardants such as aluminum trihydrate (ATH). In order to achieve the stringent flammability requirements, high loadings of ATH are necessary, often in excess of 60 percent by weight. At high loadings of ATH, there is a tendency to observe a marked deterioration of physical properties such as tensile strength, elongation, and flow in the compound.

It is thought that the functionalized additives “wet out” and adhere to the ATH surface, thereby decreasing interfacial surface tension. This allows for better dispersion and helps prevent agglomerates from re-forming within the compound. As a result, physical properties of the compound are enhanced.

Descriptions of the functionalized additives used in this study are shown in Table 1. Introducing the additives directly into the extruder is prohibitive due to their physical form. Thus, the additives were predispersed with the ATH in a high-shear blender. The result is a free-flowing powder that can be easily fed into the extruder.

Table 1. Functionalized Additives

Product	*Description*
Ricon 131 MA5	liquid polybutadiene functionalized with 5% maleic anhydride Mn = 4500, 28% vinyl
Aqueous Dispersion (AD) of Ricon 131 MA5	

A Brabender TSE-20 was used to melt blend the formulations examined in this study. The co-rotating twin-screw extruder has an L/D of 40:1 and a general-purpose mixing screw design. The additives were predispersed with the ATH and passively top fed at 20D into a melt stream of EVA (28% by weight VA). Experiments were carried out using a flat temperature profile of approximately 195 °C going from feed throat to die and a screw speed of 60 rpm. A single-strand extrudate was pulled through a water trough and pelletized. Tensile and flexural specimens were molded using a Boy Machines XS injection molder.

Microscopic examination of cross sections excised from the flexural specimens showed fewer instances of large aggregates and a relative aggregate size reduction with samples containing the functionalized additive. These images are displayed in Figure 1 below.

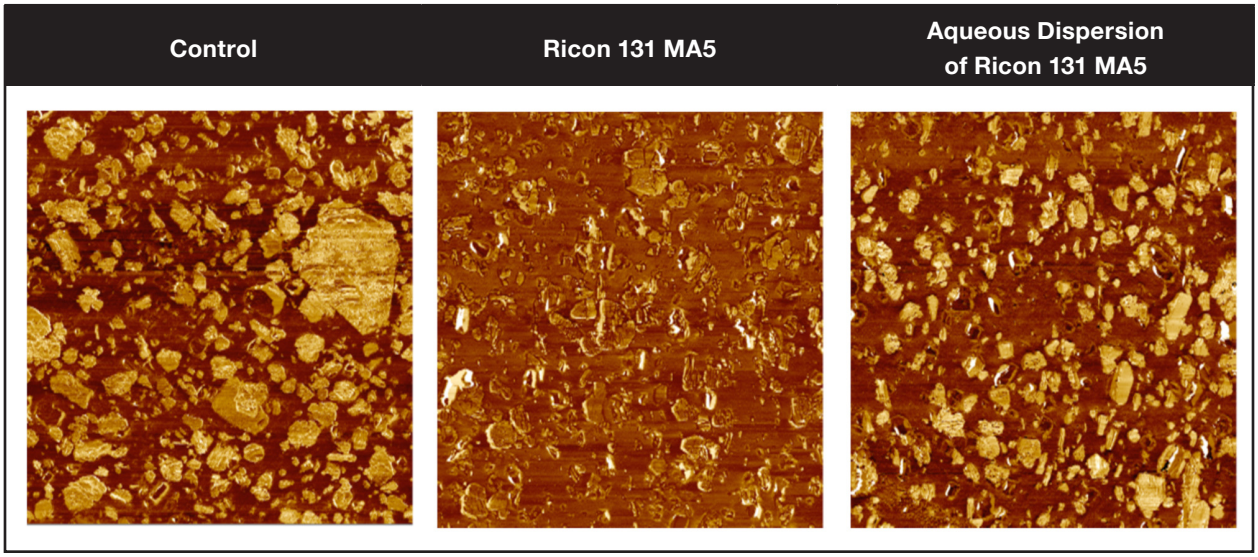

Figure 1: AFM images (20 µm scan size) of 4% additive in 60% ATH filled EVA

Reducing the instances of large aggregates and the aggregate size as well as better aggregate dispersion lessened the likelihood of providing a defect site or void formation. Thus, ductility of the compound was improved. These results are depicted in Figure 2 below.

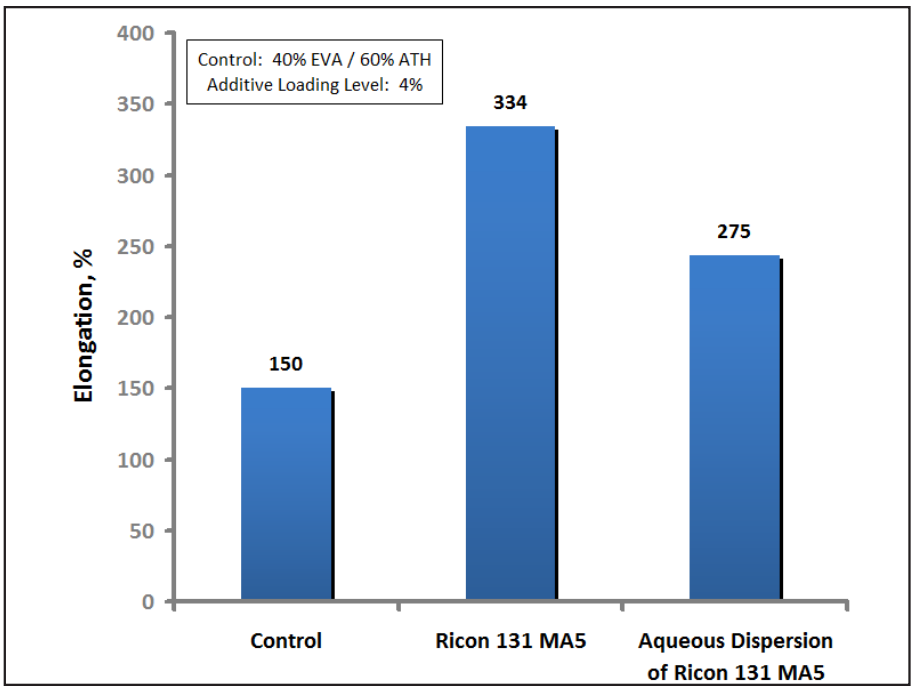

Figure 2: Effect of 4% additive in 60% ATH filled EVA on elongation

Pre-dispersing ATH with polybutadiene functionalized additive improves flammability performance with a higher limiting oxygen index, a lower UL94 rating, and no dripping. These results are depicted in Figure 3 below.

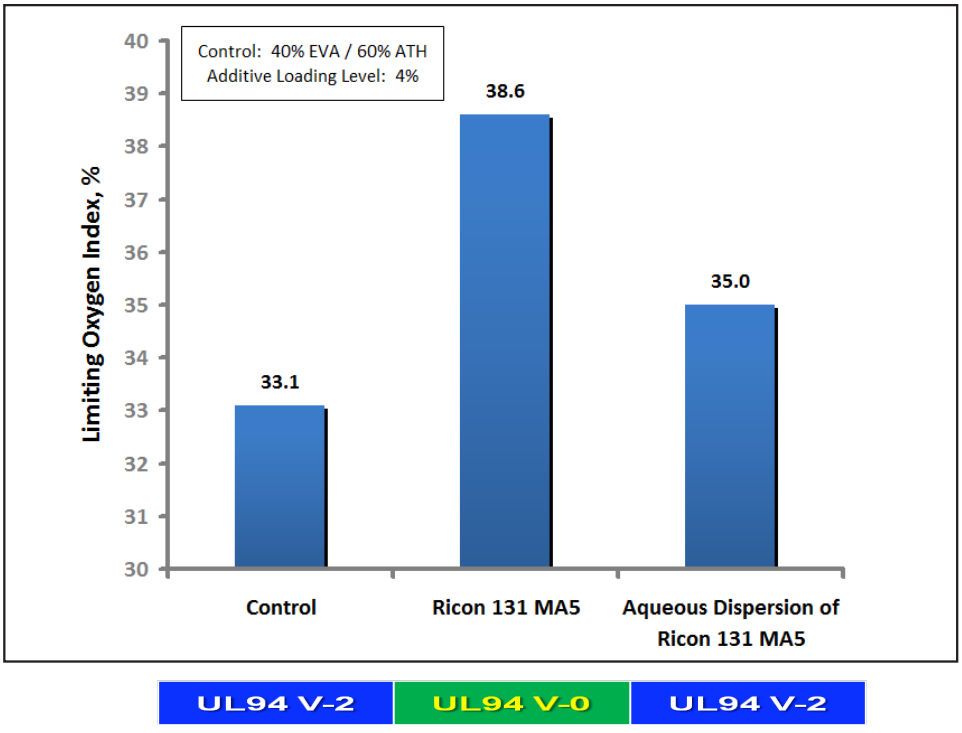

Figure 3: Effect of 4% additive in 60% ATH filled EVA on limiting oxygen index and UL94 rating

Based upon cone calorimeter testing, predispersing ATH with polybutadiene functionalized additive improves flammability performance with later onset, lower peak, and less weight loss. These results are depicted in Figures 4, 5 and 6 below.

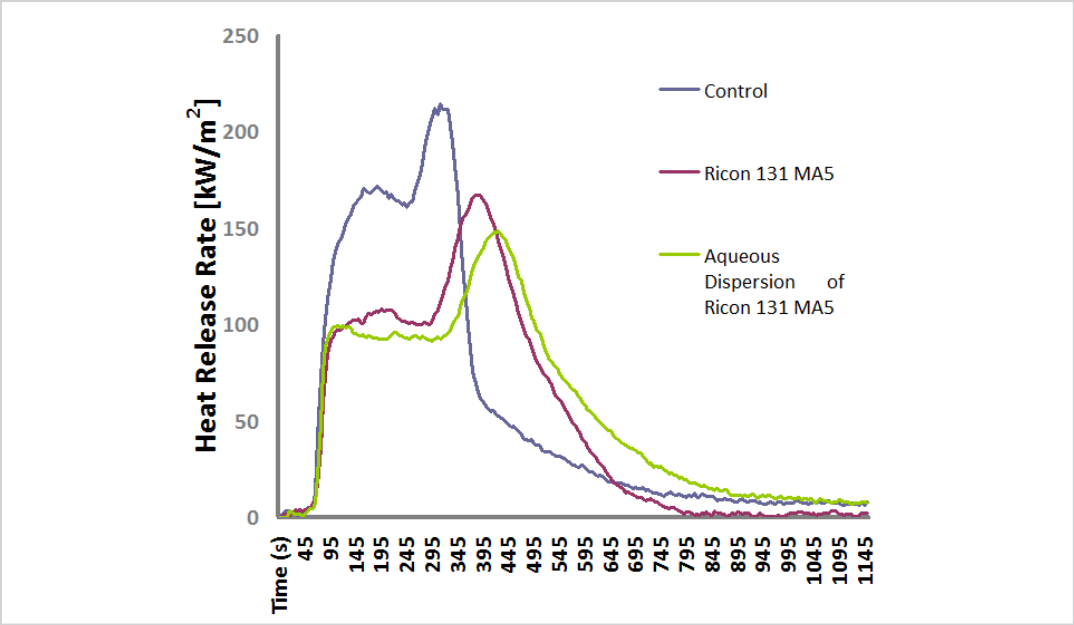

Figure 4: Effect of 4% additive in 60% ATH filled EVA on heat release Cone Calorimeter Measurements (ASTM E1354 / NFPA 271)

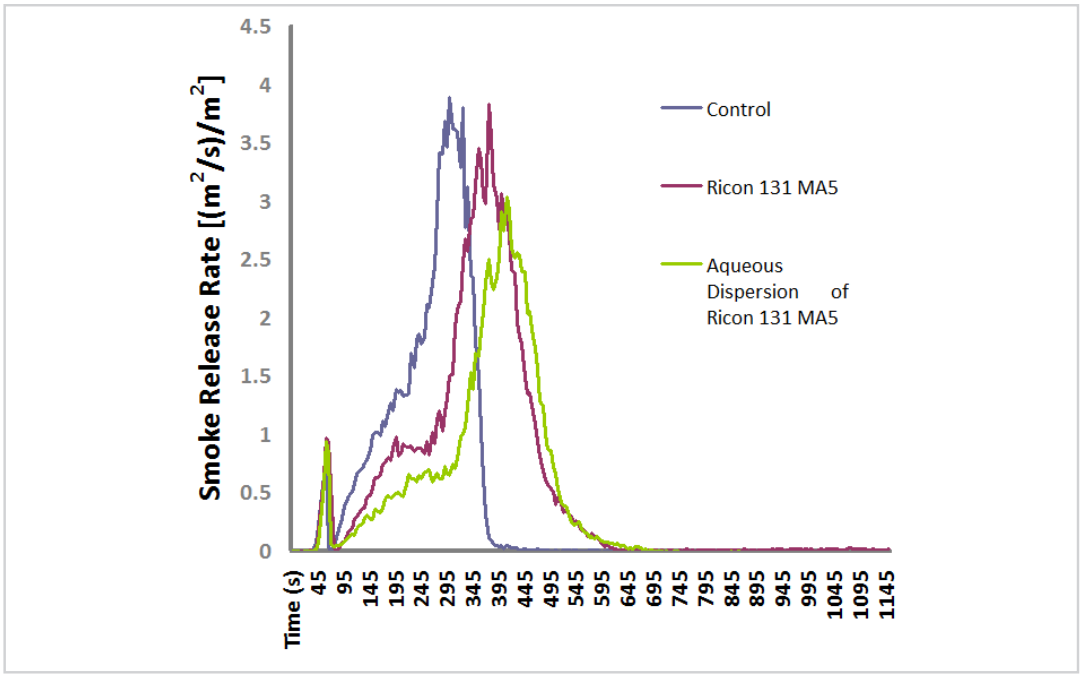

Figure 5: Effect of 4% additive in 60% ATH filled EVA on smoke release Cone Calorimeter Measurements (ASTM E1354 / NFPA 271)

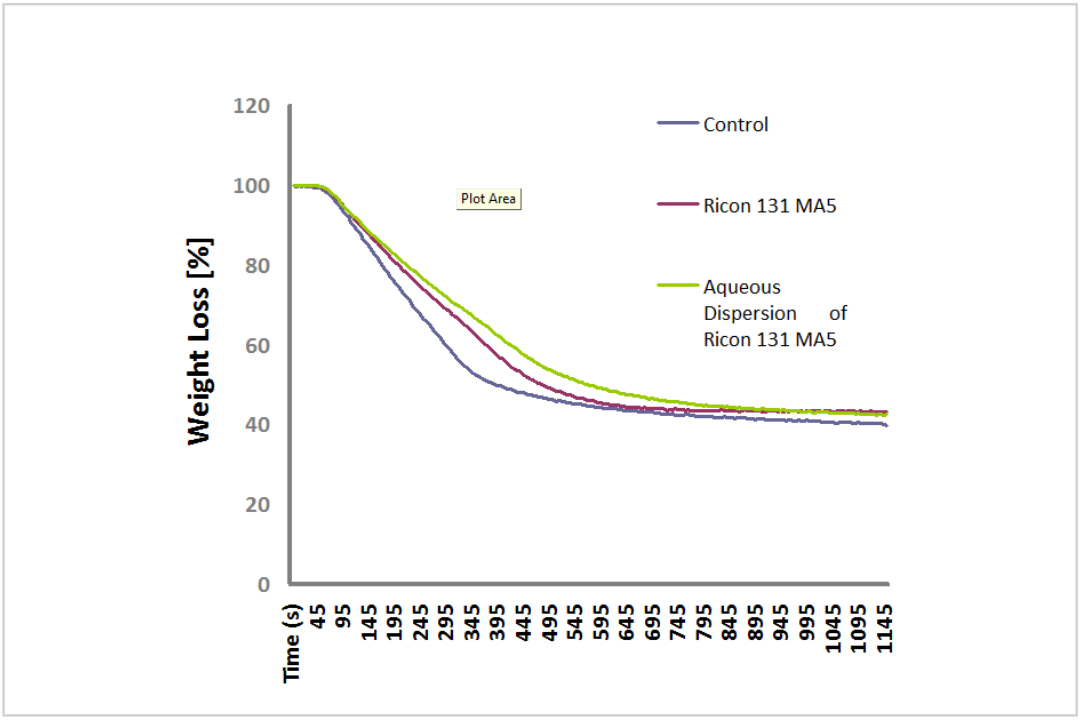

Figure 6: Effect of 4% additive in 60% ATH filled EVA on weight loss Cone Calorimeter Measurements (ASTM E1354 / NFPA 271)

Summary

Predispersing a polybutadiene functionalized additive onto ATH is an effective means to improve ductility and flammability performance through better dispersion of the coated ATH.