TECHNICAL UPDATE

CRAY VALLEY
A BRAND OF TOTAL

BENEFITS

- Melt strength improvement in extrusion and forming processes
- Extrusion stability in foaming process

SUGGESTED MARKETS/ APPLICATIONS

- Extruded foam
- Thermoforming
- Extrusion coating
- Blow molding
- Blown film
- Fiber spinning

ADDITIONAL INFO

- SDS: Dymalink 9200
- Technical Update: Rheological Modification of Polyolefins Using Dymalink® 9200

Dymalink® 9200 Processing Guide for Polypropylene

Introduction

Dymalink® 9200 is an acrylate functional zinc salt that reacts with aliphatic polymers to form a carbon-carbon covalent link. The polar zinc cations tend to assemble into ionic clusters within the polymer matrix, promoting the formation of a dynamic network as illustrated in Figure 1. This network promotes melt strength behavior, even at very low loadings. This guide will explain the optimum process conditions for activating Dymalink to create this network.

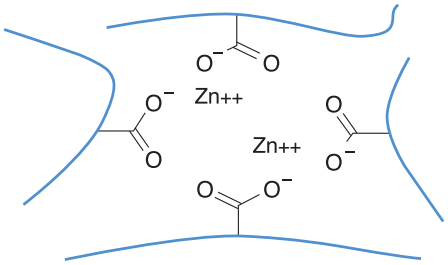

Figure 1: Schematic of the ionic cross-linking system.

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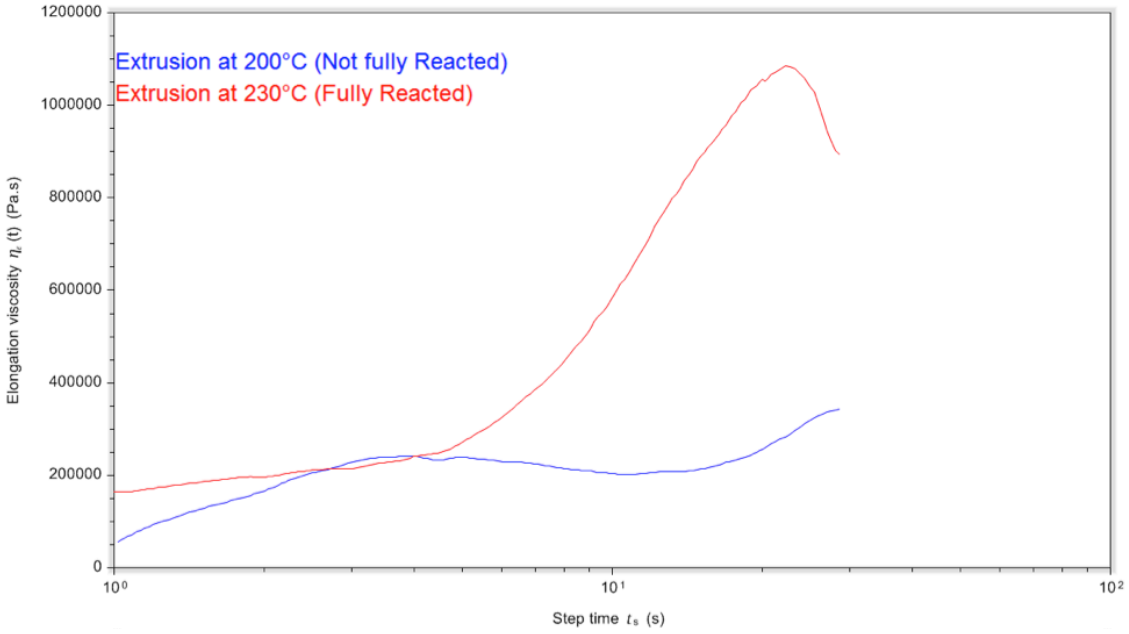
It is important to achieve extrusion conditions to promote grafting of Dymalink onto the polypropylene backbone. This is illustrated in Figure 2. “Extrusion at 200°C” and “Extrusion at 230°C” correspond to the maximum barrel set temperatures in a 20 mm Brabender twin-screw extruder. The increase in elongational viscosity at the higher temperature indicates the required condition for activating the ionic network. See Table 1 for the “Extrusion at 230°C” extrusion profile.

Figure 2: Elongational viscosity (η) versus time. 0.1s^{-1} strain rate. T=180°C. 2.8 MFI PP homopolymer + 2 wt.% Dymalink 9200



Suggested Process Conditions

Zone 1	Zone 2	Zone 3	Zone 4	Zone 5	Adapter	Die
23°C	230°C	230°C	230°C	220°C	220°C	210°C
74°F	445°F	445°F	445°F	430°F	430°F	410°F

Table 1: Suggested extrusion profile

For operations requiring lower temperatures, a decreasing temperature profile can be used (provided 230°C activation temperature is achieved). An example of this is shown in Table 2.

Decreasing Temperature Profile

Zone 1	Zone 2	Zone 3	Zone 4	Zone 5	Adapter	Die
23°C	230°C	230°C	180°C	180°C	180°C	185°C
74°F	445°F	445°F	355°F	355°F	355°F	365°F

Table 2: Decreasing extrusion profile

Experimental

A 2.8 MFI PP homopolymer was compounded with 2% loading of Dymalink in a 20 mm Brabender twin-screw extruder with different extrusion profiles. The sample marked with “Extrusion at 200°C” only achieved a maximum barrel temperature of 200°C (392°F), while the sample marked “Extrusion at 230°C” used the temperature profile in Table 1. The samples were tested using the SER-3 extensional viscosity fixture on a TA Instruments DHR-2 rheometer.

Extensional testing was conducted at a constant strain rate of $0.1s^{-1}$ and T=180°C. At this strain rate, Dymalink 9200 caused strain hardening as seen from the deviation from linear viscoelastic behavior at t=10s. The higher elongational viscosity response suggests a higher level of molecular chain entanglements due to ionic associations. The sample that was extruded at 200°C has not fully reacted, so the melt elongational viscosity does not increase like the sample extruded at 230°C, as shown in Figure 2.

Summary

Addition of Dymalink 9200 to conventional PP improves its melt strength, allowing for improved processability in conversion operations such as extruded foam, thermoforming, extrusion coating, blow molding, and profile extrusion. To fully realize the melt strength enhancement from Dymalink 9200, it is important to process the polymer at temperatures that are sufficient to activate the mechanism. Dymalink 9200 allows converters flexibility to tailor compounds to their specific end-use needs versus the use of conventional HMS PP. These materials are commercially available globally.

About TOTAL Cray Valley

TOTAL Cray Valley is the premier global supplier of specialty chemical additives, hydrocarbon specialty chemicals, and liquid and powder tackifying resins used as ingredients in adhesives, rubbers, polymers, coatings, and other materials. TOTAL Cray Valley has pioneered the development of these advanced technologies, introducing hundreds of products that enhance the performance of products in energy, printing, packaging, construction, tire manufacturing, electronics, and other demanding applications.

For more information, please visit our website at **www.crayvalley.com**.

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