TECHNICAL UPDATE

BENEFITS

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

SUGGESTED MARKETS/ APPLICATIONS

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

ADDITIONAL INFO

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

Increasing Regrind Levels in High-Melt-Strength Polypropylene Using Dymalink® 9200

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.

Some secondary processes, such as thermoforming or extruded foam, use HMS-PP and produce a large amount of scrap that is shredded, repelletized, and added back to the original compound. Due to low melt strength of the regrind only a small amount can be incorporated back into the base compound. Dymalink 9200 can increase the melt strength of this regrind.

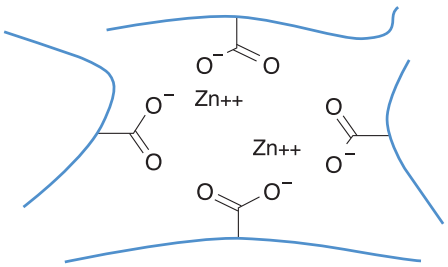

Figure 1: Schematic of the ionic cross-linking system.

Experimental

Simulated regrind material was created by passing a commercially available HMS PP through a twin-screw extruder up to 4 times. This regrind material was then compounded with Dymalink 9200 at 1%, 1.5% and 2% addition levels. Specimens were cut from compression molded sheets and tested on a TA Instruments DHR-2 using a SER3 elongational viscosity fixture. Elongational viscosity testing was performed at 180°C using a constant strain rate of $0.1s^{-1}$.

In the first stage of testing, one pass through the extruder was enough for the HMS PP to see a reduction of melt viscosity of 90%, shown in Table 1. During this study the 1.5% loading of Dymalink 9200 was optimum for this material and increased the elongational viscosity from 125,000 to 1,139,000 Pa.s, an increase of over 800%.

Table 1: HMS PP regrind: various levels of Dymalink 9200. Elongational viscosity at 180°C and $0.1s^{-1}$ strain rate.

Extrusion Passes	HMS PP (Pa.s)	1% Dymalink (Pa.s)	1.5% Dymalink (Pa.s)	2% Dymalink (Pa.s)
0	1,271,700	–	–	–
1	125,000	–	–	–
2	128,000	603,000	1,139,000	1,004,000
3	99,000	817,000	658,000	426,000
4	54,000	728,000	462,000	452,000

In the second stage of testing, the regrind sample containing 1.5% Dymalink was blended into virgin HMS PP and compared against compounded regrind containing no Dymalink. The regrind addition was increased by 5% increments up to 25% of the total compound. Specimens were compression molded and tested for elongational viscosity at 180°C and a strain rate of $0.1s^{-1}$.

The elongational viscosity of the 95/5 base compound/regrind control was measured at 587,000 Pa.s. Using the regrind with 1.5% Dymalink 9200, an elongational viscosity of 687,000 Pa.s was achieved with 25% regrind level. The Dymalink-modified regrind at 5% level achieved a higher melt viscosity than the virgin HMS PP at 1,565,000 Pa.s compared to 1,270,000 Pa.s of the virgin HMS PP. Further, the Dymalink-modified regrind allows for up to 20% regrind incorporation while maintaining over 1,000,000 Pa.s elongational viscosity, as shown in Table 2.

Table 2: Base compounds with regrind: Elongational viscosity at 180°C and $0.1s^{-1}$ strain rate. Parallel plate rheology G'/G" crossover point T=190° C. Melt flow rate 230°C/2.16 kg.

	Elongational Viscosity		Melt Flow Rate	
Virgin to HMS-PP Ratio	Control (Pa.s)	1.5% Dymalink 9200 (Pa.s)	Control (g/10 minutes)	1.5% Dymalink 9200 (g/10 minutes)
100/0	1,270,000	–	2.1	–
95/5	587,000	1,565,000	6.1	6.3
90/10	61,000	1,183,000	6.5	6.3
80/20	63,000	1,019,000	6.4	6.4
75/25	–	687,000	–	6.6

Summary

Addition of Dymalink 9200 to HMS PP regrind improves its melt strength, allowing for significantly higher levels of regrind in melt-strength sensitive operations such as extruded foam, thermoforming, extrusion coating, blow molding, and profile extrusion. Dymalink 9200 allows converters flexibility to tailor PP-based compounds to their specific end-use needs. Dymalink 9200 is commercially available globally.

About Resin Solutions

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