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Dynamar™

Polymer Processing Additives (PPAs) to Improve the HDPE Blow Molding Process

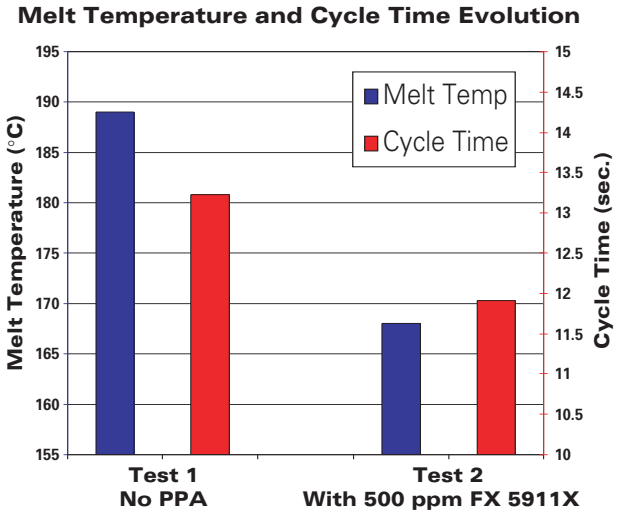
Dynamar Polymer Processing Additives (PPAs) are additives designed to improve polymer extrusion. Applications include blown and cast film, blow molding, monofilament, fibers, pipe & tubing and wire & cable. Dynamar processing additives such as FX 9613, FX 9614 FX 5920A, FX 5922 and FX 5911 have shown the following performance benefits in HDPE blow molding:

- Reduction of Cycle Time
- Surface and Gloss Improvement
- Improved Control of Die Swell and Product Weight
- Reduction in transition time between pigment changes
- Higher Output and Overall Productivity

Blow Molding Evaluation

Productivity improvement

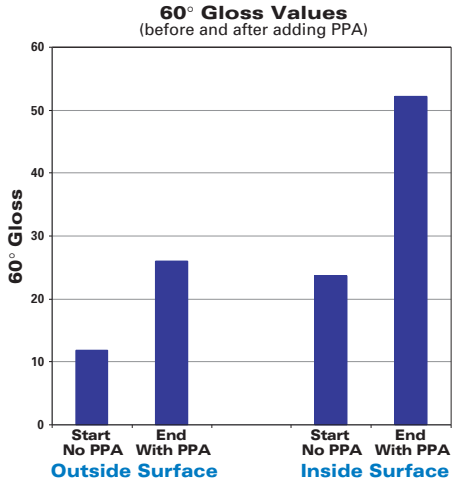
Dynamar FX 5911 was evaluated in a blow molding process for the production of 50 ml (31.3 g) bottles. The formulation tested was a HDPE resin (0.3 MFR $_{(2.16\ kg/190°C)}$, 0.956 density) containing 6% TiO_2. 500 ppm of PPA was added via a concentrate during the experiment. The use of the processing additive allowed for the reduction in the extruder temperature settings because it effectively reduced the apparent shear stress of the resin and prevented the onset of surface defects such as melt fracture. The resulting lower melt temperature allowed for a reduction in the cycle time of the blow molding process, resulting in a higher production rate. Additionally, the use of PPA resulted in a higher gloss on the final bottles.



This graph shows the melt temperature and the corresponding cycle time. Test 1 is at the start of the experiment, before PPA was added. Test 2 corresponds with the final parameters after the PPA was added. The addition of 500 ppm of FX 5911 allowed for a reduction in the extrusion temperature. The resulting lower melt temperature allowed for a decrease in the process cycle time because cooling time could be shortened.

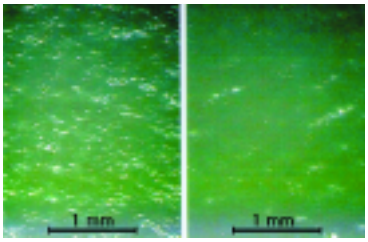
Surface and Gloss Improvement

The 60° gloss was measured on different samples during the production of the bottles. This graph shows the experimental values (an average of 10 measurements) of the inside and outside surfaces. In both cases, values are represented for samples at the start of the experiment (before the addition of PPA) and at the end at the experiment (after the addition of PPA and after lowering the temperature and cycle time).



The photomicrographs below demonstrate the elimination of micro-melt fracture during the production of the bottles.

Photographs of the Outside Surface of the Bottles



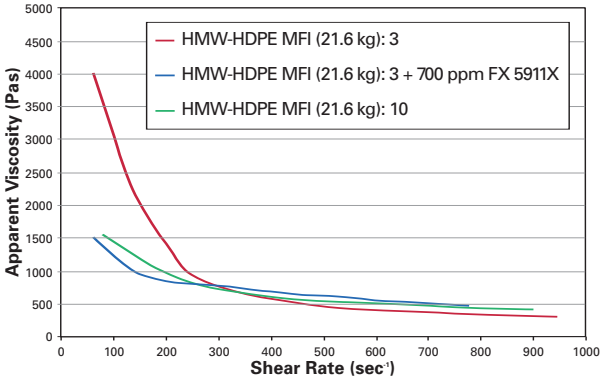
Without PPA | With 500 ppm FX 5911

Mechanism Background

Reduction of Apparent Viscosity of HMW-HDPE Resins

Dynamar processing additives allow resins to process as if they had a lower melt viscosity. The graph below shows the apparent viscosity of a HMW-HDPE resin (3 MFI(21.6 kg), 0.950 density) and the apparent viscosity reduction caused by the addition of 700 ppm FX 5911. Cyclic melt fracture and slip occurs from a shear rate of less than 200 sec^{-1} without PPA. No melt fracture was observed with PPA present up to a shear rate of 1000 sec^{-1}. Rheological data of a 10 MFI resin are included as a reference.

The use of Dynamar PPA allows the processor to utilize the better mechanical properties associated with a lower MFI resin without running into many of the typical problems with the processablitiy of the resins.



Capillary Rheometry: T= 220°C, capillary diameter=2 mm, L/D 15

Technical Information and Test Data

Technical information, test data, and advice provided by Dyneon personnel are based on information and tests we believe are reliable and are intended for persons with knowledge and technical skills sufficient to analyze test types and conditions, and to handle and use raw polymers and related compounding ingredients. No license under any Dyneon or third party intellectual rights is granted or implied by virtue of this information.

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