Application Note
LR-19

Differentiating Polypropylene Samples from different Suppliers with the Same MFR Value

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Introduction

Biaxially oriented films based on polyolefins are widely used in packaging industry.
The polypropylene (PP) films are often produced in a biaxial stretching process, in which the film is drawn at a specific temperature.

This application report is based on a test done for a customer who was manufacturing biaxial stretched films and was using PP from two different suppliers.
The PP from these suppliers had the same MFR value (2.9 g/10 min) and the customer expected them to have the same processing behaviour. But despite having the same MFR value, one of the PP materials gave them problems during manufacturing, because the extruded PP film braked during the stretching process.

Test Equipment

- Torque rheometer system Thermo Scientific HAAKE PolyLab
- Electrically heated laboratory mixer Thermo Scientific HAAKE Rheomix600
- Roller rotors
- Thermo Scientific HAAKE PolySoft Mixer software

Test Conditions

- Mixer temperature: 200 °C
- Rotor speed:
  Step 1: 60 rpm for 7 min, then
  Step 2: 190 rpm for 18 min
- Sample weight: 45 g

Test Procedure

The exact amount of PP pellets is forced into the running and hot mixer by means of a feeding ram. The rotor speed is set in two different speed steps. During the loading and for the sample melting the speed is kept to 60 rpm. After 7 minutes the speed of the mixer is increased up to 190 rpm in order to accelerate the polymer degradation. After further 18 minutes the test is finished, the motor stops and the mixer can be cleaned. During the whole test the torque and the melt temperature are measured and recorded.

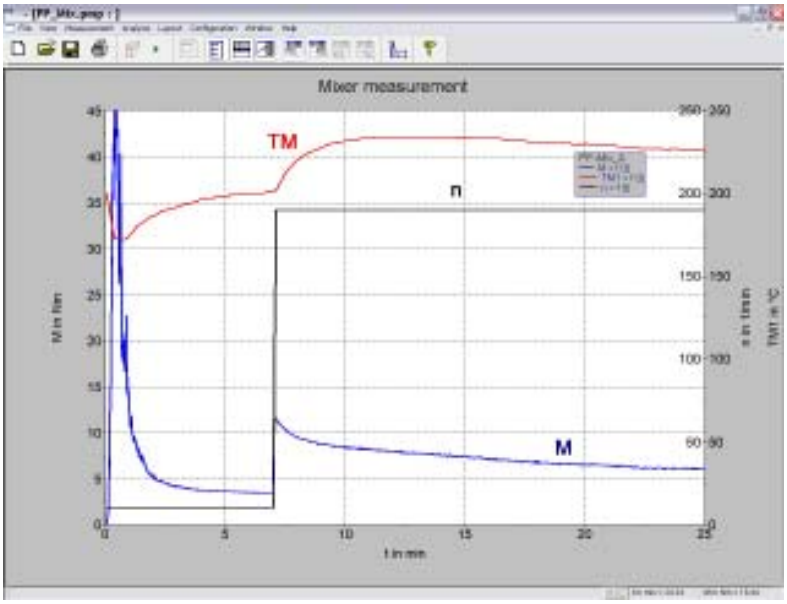

Figure 1

Test Results

Figure 1 shows the result of the measurement with sample A. The graph shows the torque (M), the melt temperature (TM) and the rotor speed (n) as a function of test time.

Basic Curve Discussion

The initial filling of the mixer results in the first torque increase, the so called Loading Peak. After this first maximum the torque value drops due to the melting of the sample material.

The second torque maximum is caused by the change of the rotor speed from 70 rpm to 190 rpm. The higher mixer speed results in higher shear and also leads to an increase in melt temperature. The torque which correlates with the melt viscosity of the polymer decreases due to degradation of the sample.

Comparison of Test Results

The test results of both samples are shown superimposed in Figure 2. In the beginning of the test, at 70 rpm, the two samples showed no significant difference. At the mixer speed of 190 rpm, it can clearly be

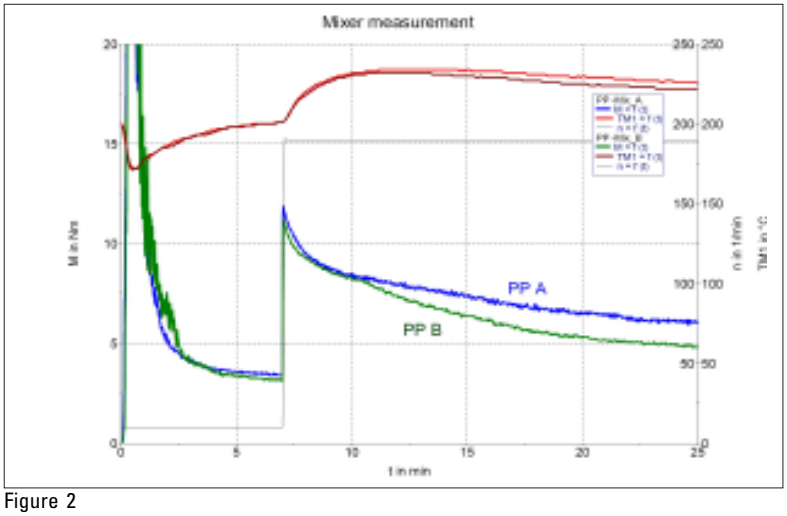

Figure 2

seen that sample B degrades faster than sample A. So sample B seams to be much less stable to higher shear rates than sample A.

Conclusion

The MFR value is measured at very low shear rates and is therefore not suitable to detect the differences between the two PP samples. With the measuring mixer it was possible to measure under much more production-like conditions. Because of this it was possible to clearly differentiate the two PP samples.

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LR-19_03.12.08