Plastic Additives

STRUKTOL® TR 451: Improvements When Using Mineral Fillers

Summary and Data

December 2012

STP0286

STRUKTOL® TR 451

- Functional viscosity modifier and in-situ mineral filler treatment for use in polyolefins
- Can replace treatment chemistries
- Provides metal release characteristics, lubrication and improved dispersion
- Improved physical and aging properties
- Easy to handle and feed at the extruder or molding machine

TR 451 Experimental Formulas

	TREAT	UNTREAT	A	B	C
PP Resin	60	60	59.6	59.4	59.2
FT CaCO3	40				
F CaCO3		40	40	40	40
Additive Trials			0.4	0.6	0.8

Two separate PP homopolymer resins were evaluated to determine viscosity effects:

- Nominal 5 MFR
- Nominal 12 MFR

Calcium Carbonate used has a particle size of 1.4μm

Laboratory Experiments/Testing

Data generated is based on compounding on a Brabender PL2000 torque rheometer using the bowl mixer equipped with cam blades at 180°C and 70 rpm. The total time of the mixing cycle was 800 seconds.

Capillary rheometer testing was performed on a Shimadzu CFT-500C equipped with a 10 mm by 1 mm diameter die and set at 200°C. A variety of shear rates were used to give a complete viscosity picture.

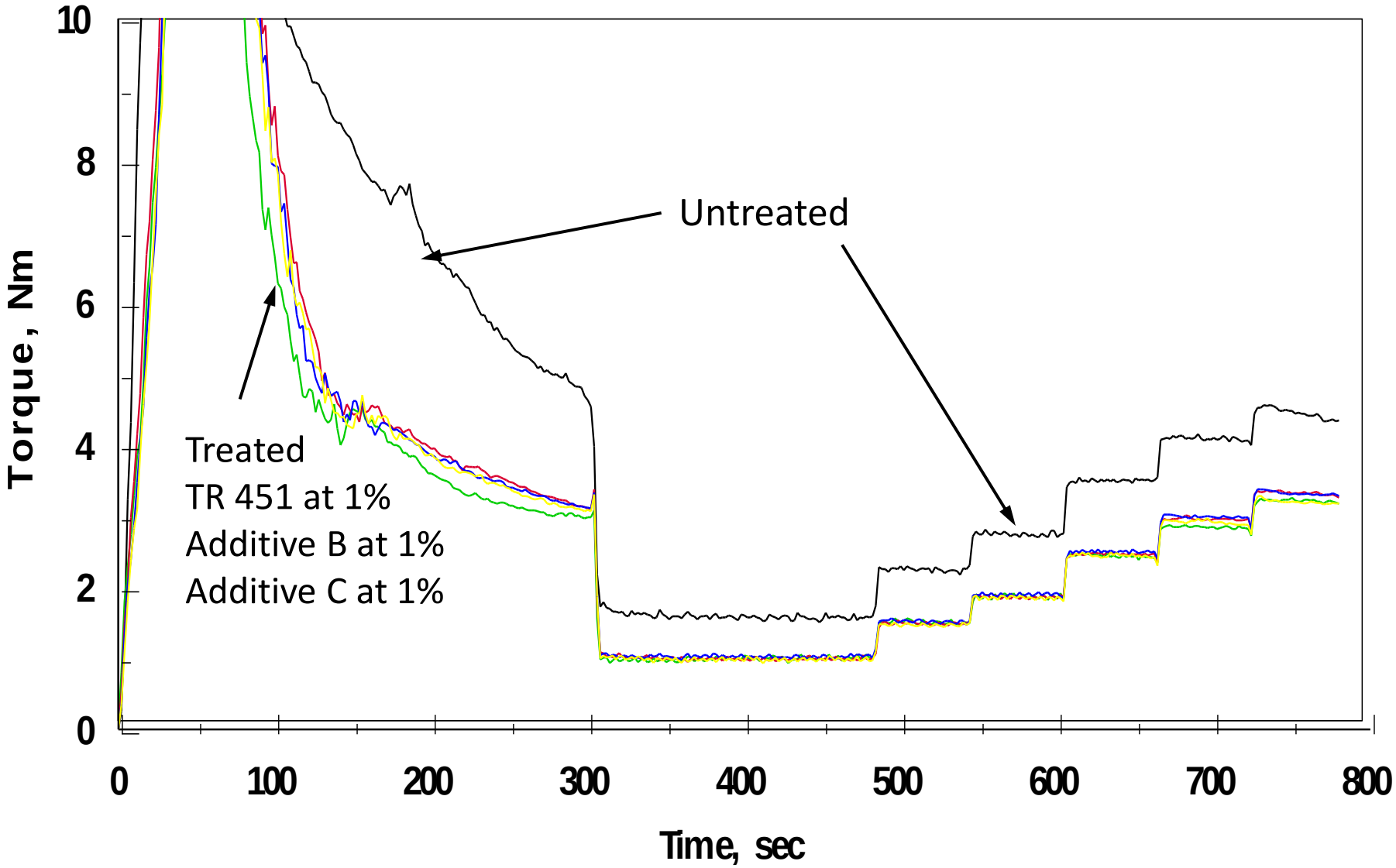
Physical property data was generated using injection molded test specimens prepared on a Cincinnati Milacron 33 ton lab molding machine:

Color measurements were taken on injection molded specimens using a Minolta Spectrophotometer.

Thermal stability measurements were made on a Mettler Toledo DSC at 10°C/min.

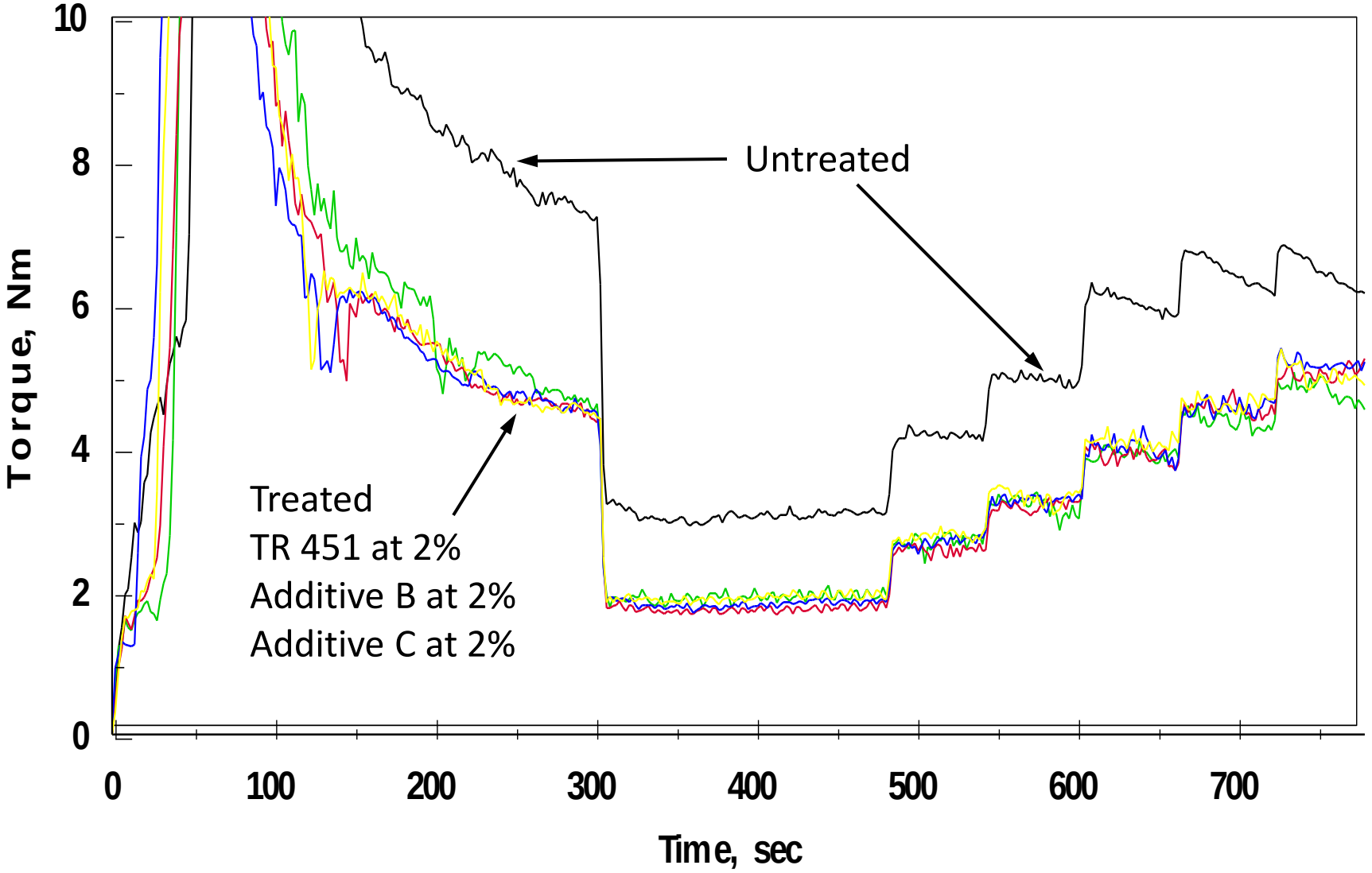
MIXING OF 40% CaCO3 FILLED COMPOUNDS

Nominal 12 MFR Polypropylene



MIXING OF 40% CaCO3 FILLED COMPOUNDS

Nominal 5 MFR Polypropylene



Mixing Results Summary

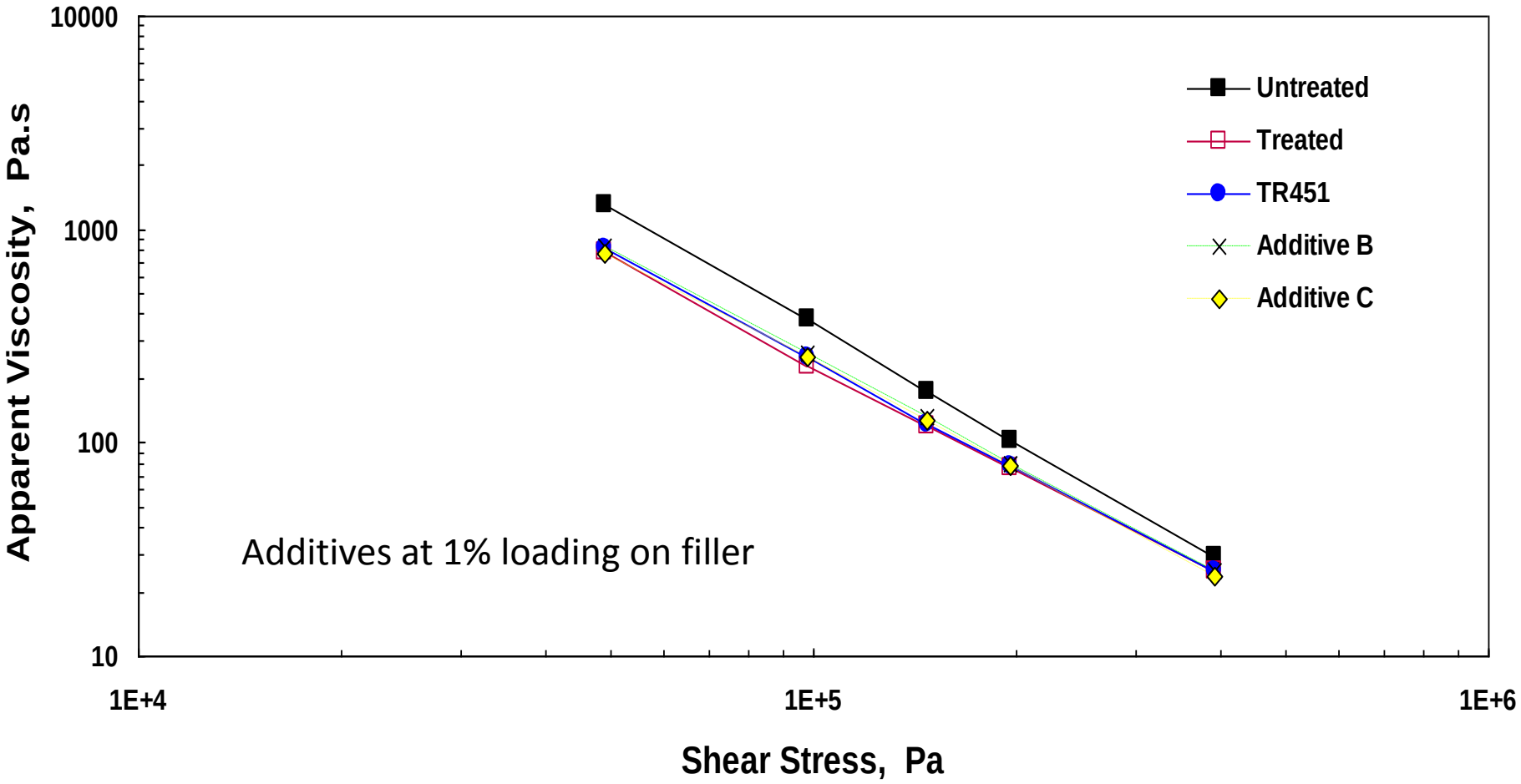
- Untreated $CaCO_3$ with no additives showed higher torques throughout the mixing cycle and the resulting compound displayed poor dispersion with residue $CaCO_3$ left in the bowl.

- The treated $CaCO_3$ showed improved wetting characteristics resulting in lower torques throughout the mixing cycle. The resulting compound displayed good dispersion and color.

- The untreated $CaCO_3$ with TR 451 added showed wetting and mixing characteristics typical of treated $CaCO_3$. The resulting compound displayed good dispersion and color.

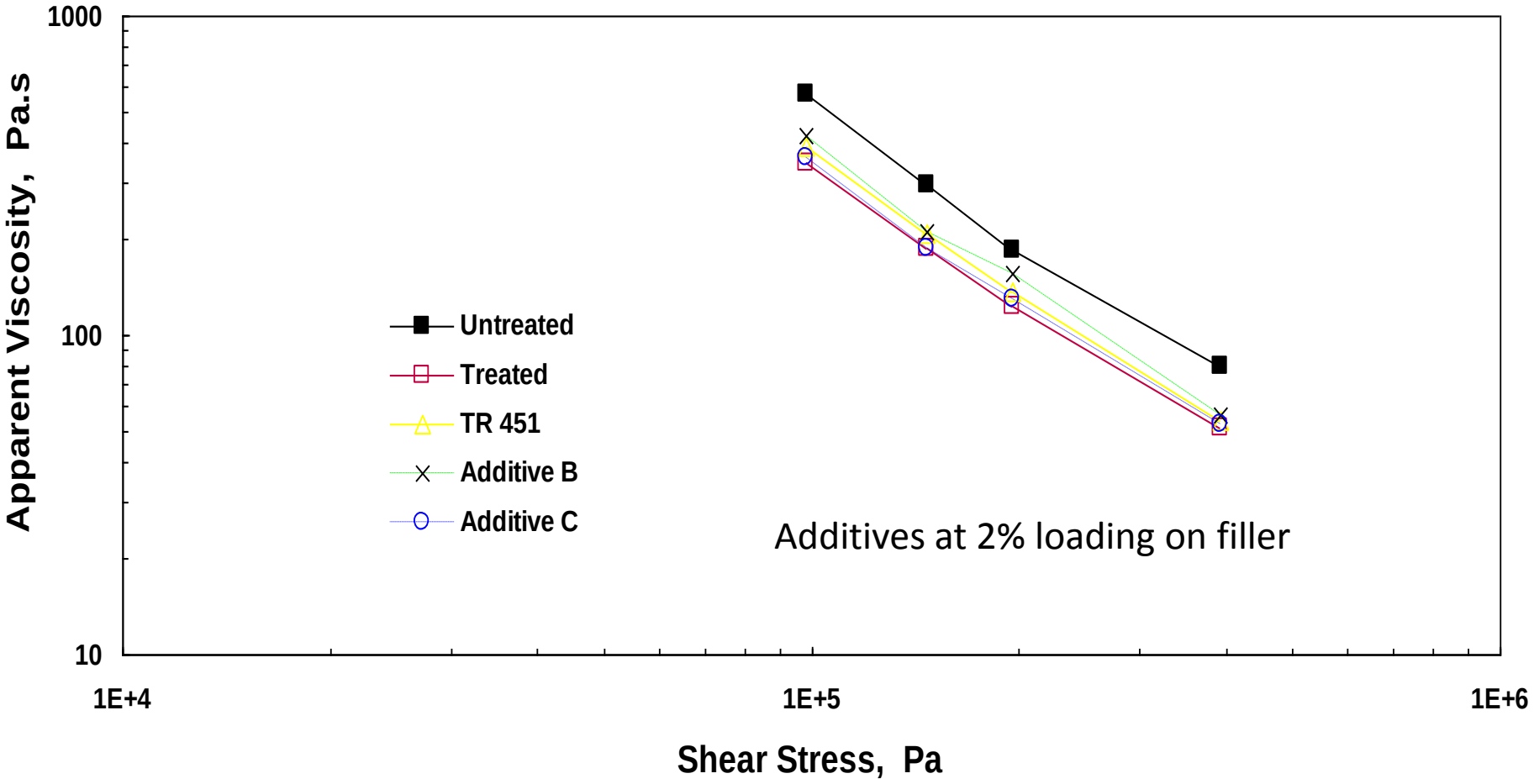
VISCOSITY AND SHEAR STRESS AT 200°C

Nominal 12 MFR Polypropylene



VISCOSITY AND SHEAR STRESS AT 200°C

Nominal 5 MFR Polypropylene



Viscosity Results Summary

- Untreated $CaCO_3$ with no additives had higher melt viscosities across the shear range when compared to treated $CaCO_3$.

- The untreated $CaCO_3$ with TR 451 added had melt viscosities comparable to treated $CaCO_3$ across the shear range.

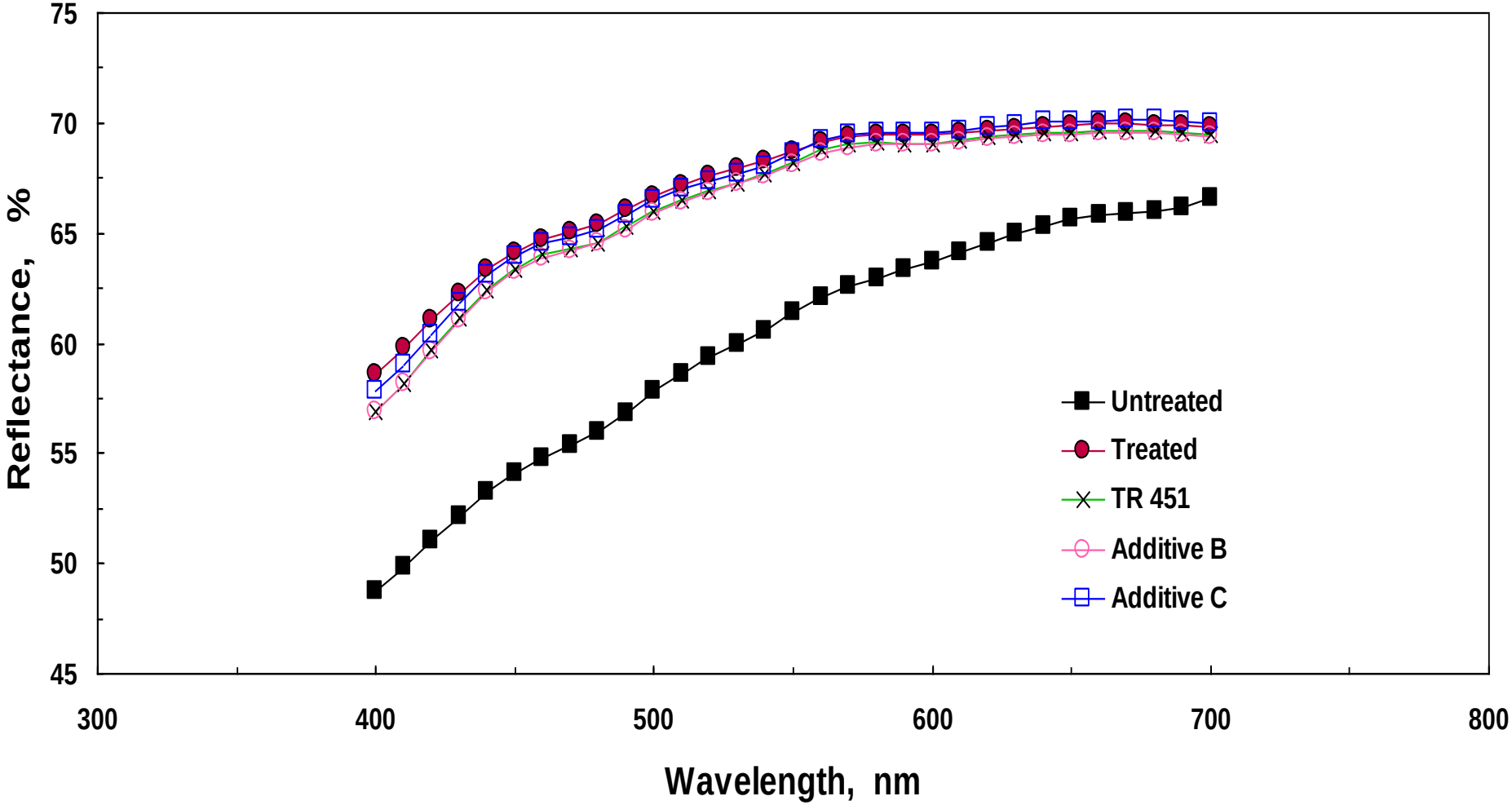
Color Development

Description	L*	a*	b*	C*	h
In 12 MFR Polypropylene					
Untreated	85.2	0.6	4.5	4.6	82.4
Treated	87.2	-0.3	3.5	3.5	94.3
TR 451 - 1%	88.1	-0.3	3.5	3.5	95.0
Additive B - 1%	87.8	-0.3	3.6	3.6	94.0
Additive C - 1%	88.3	-0.3	3.3	3.3	95.0
TR 451 - 1.5%	88.2	-0.3	3.3	3.3	95.6
Additive B - 1.5%	88.1	-0.3	3.4	3.4	95.0
Additive C - 1.5%	88.2	-0.3	3.4	3.4	95.1
In 5 MFR Polypropylene					
Untreated	84.2	0.7	6.5	6.5	84.2
Treated	86.4	-0.5	5.2	5.2	96.0
TR 451- 1.5%	87.6	-0.6	5.5	5.5	96.5
Additive B - 1.5%	88.0	-0.4	5.0	5.0	95.1
Additive C - 1.5%	87.7	-0.5	4.7	4.7	96.1

REFLECTANCE BY SPECTROPHOTOMETER

Nominal 12 MFR Polypropylene

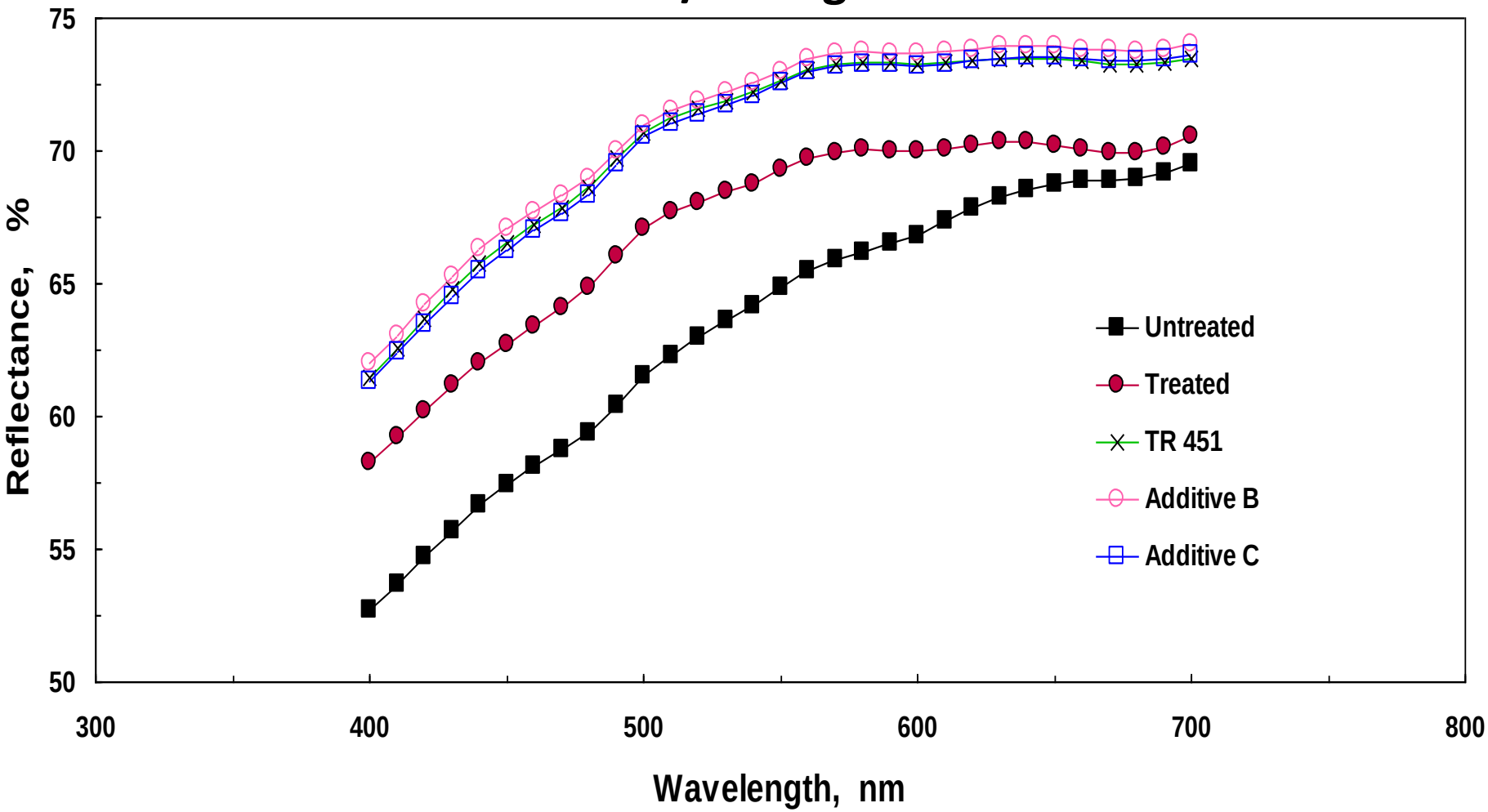
D65/10 degree



REFLECTANCE BY SPECTROPHOTOMETER

Nominal 5 MFR Polypropylene

D65/10 degree



Color/Surface Results Summary

- Untreated $CaCO_3$ with no additives gives a more yellow/grey compound when compared to treated $CaCO_3$.
- The untreated $CaCO_3$ with TR 451 gives a much whiter compound comparable with and in some cases better than the treated $CaCO_3$.
- In the 5 MFI PP compound, reflectance data shows a much whiter, glossier, more polymer rich surface in the untreated $CaCO_3$ with TR 451.

TR 451 Effects on Physical Properties

In Nominal 12 MFR Polypropylene

	Flexural Strength, MPa	Flexural Modulus, MPa	Notched Impact, J/m	Unnotched Impact, J/m
Untreated CaCO3	44.1	2190	75	641
Treated CaCO3	48.6	2800	150	No Break
TR 451 – 1% on Filler	49.0	2640	171	No Break

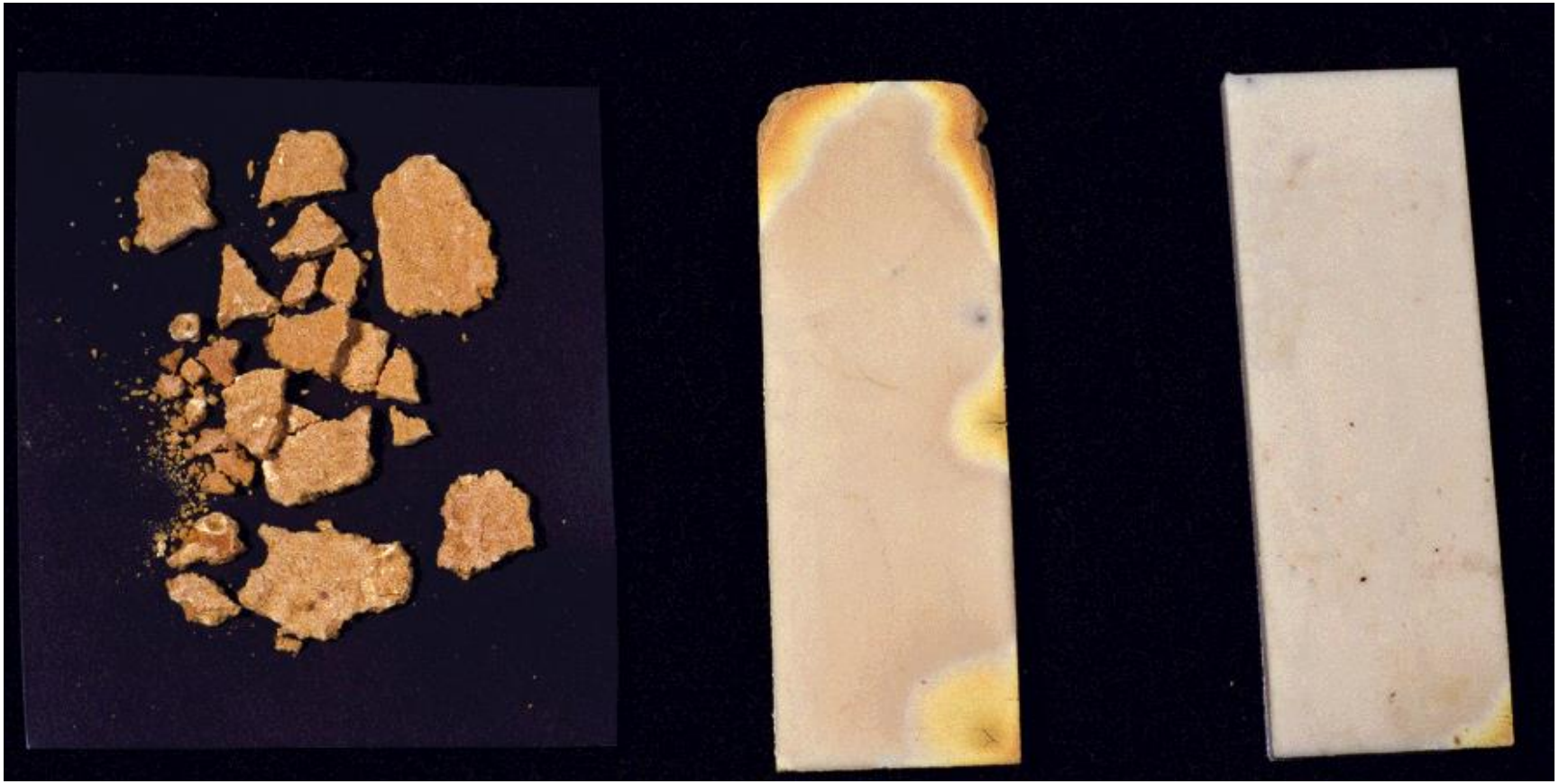
TR 451 Effects on Thermal Properties

In Nominal 12 MFR Polypropylene

	Melt Temperature, °C	Degradation Temperature, °C
Unfilled Polymer	166	246
Untreated CaCO3	168	231
Treated CaCO3	166	237
TR 451 – 1% on Filler	167	248

TR 451 Effects on Thermal Properties

In Nominal 12 MFR Polypropylene
Oven Aged 168 hours at 150°C



12 MFR PP + Untreated CaCO3

12 MFR PP + Treated CaCO3

12 MFR PP+Untreated CaCO3 + TR 451 at 1% on filler

Physical/Thermal Results Summary

- The untreated $CaCO_3$ with TR 451 gives equal/better physical properties versus treated $CaCO_3$
- The untreated $CaCO_3$ with TR 451 results in a more thermally stable compound born out by the degradation temperature increases and the oven aging resistance.

TR 451 Summary:

- Allows for use of untreated filler in place of treated filler
- Provides equal or better processing and physical characteristics
- Leads to lower cost formulations when comparing treated vs. untreated fillers