

Heat Seal Characteristics of Cyclic Olefin Copolymer / Polyethylene Blends

Introduction



- **Cyclic Olefin Copolymers (COC) use is growing in flexible packaging films**
- **Attributes include easy processing, stiffness, heat resistance, moisture barrier and clarity**
- **Can be used to modify the heat sealing characteristics of polyethylenes:**
 - ▶ improvements in seal strength
 - ▶ improvement of hot-tack strength
 - ▶ high temperature seal through capability with high Tg grades.

Experimental

■ <u>Materials:</u>	<u>MI</u>	<u>Density</u>	<u>T_g °C</u>
▶ Dow 2045 LLDPE	4	0.920	-127
▶ Equistar NA 952 LDPE	2	0.918	-127
▶ Equistar NA 204 LDPE	3	0.931	-127
▶ Borealis 7230 LDPE	4.5	0.923	-127
▶ Exxon Mobil 3125 Plastomer	1.2	0.91	-121
▶ Dow 1140 Plastomer	1.2	0.902	-121
▶ TOPAS 8007 COC	1.8	1.02	80 (low)
▶ TOPAS 5013 COC	< 1.0	1.02	136 (high)

■ Extrusion:

- ▶ 25 mm Killion (DS), DSB I barrier type screw, 30: 1 L/D, Maddock Mixing head
 - T range: 160 - 260°C, Cast rolls: 35°C, film: 51 microns

■ Testing Equipment:

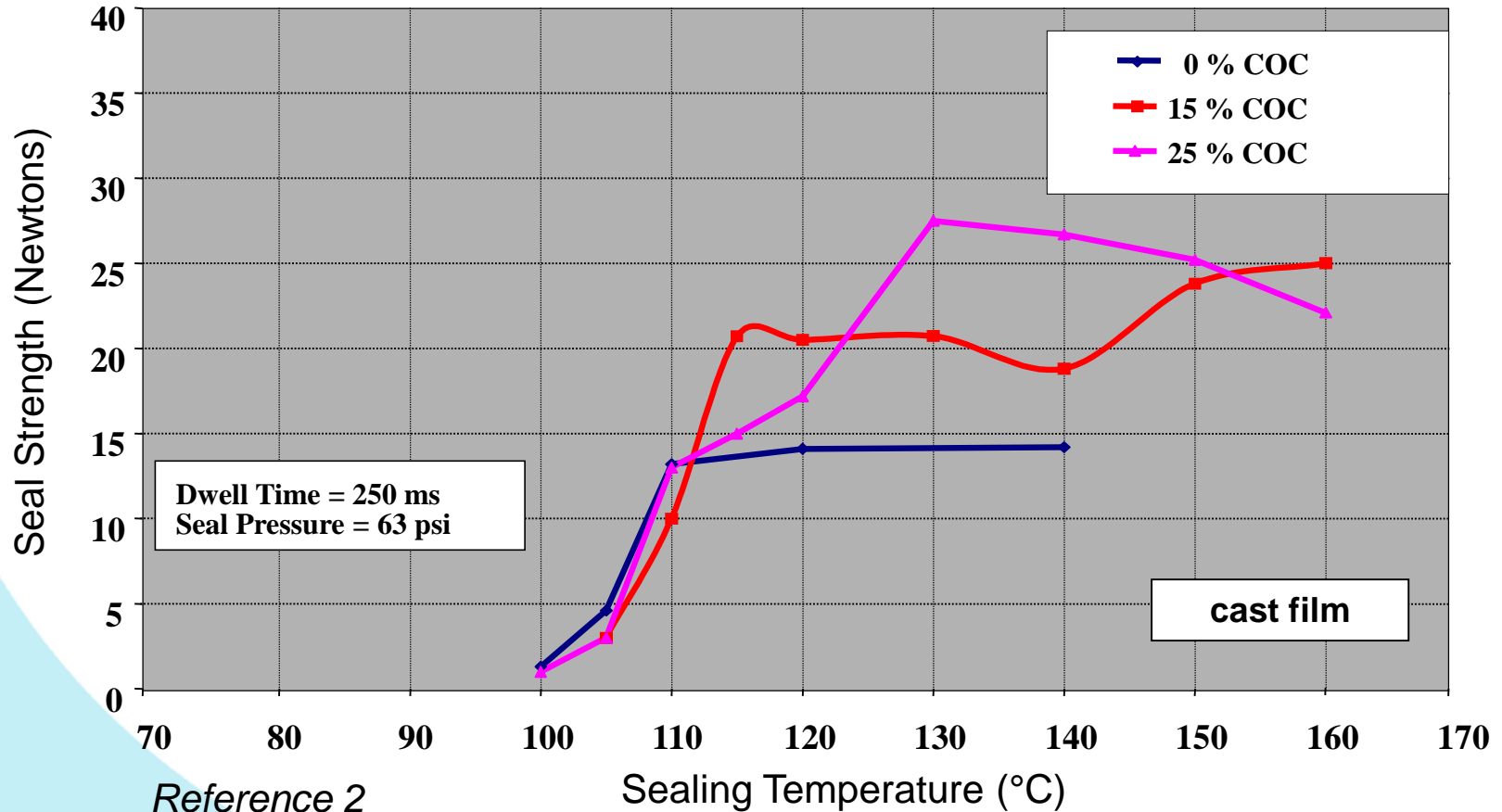
▶ Heat Seal Davinor Inc., J&B Hot Tack Tester

- ▶ Seal Strength Test - Seal Pressure = 0.3034 N/mm (44psi), Seal Time = 1 sec., Cool Time = 30 sec., Peel speed = 200 mm/sec, sample size = 25.4 mm (1 inch) wide.
- ▶ Hot-Tack Test - Seal Pressure = 0.3034 N/mm (44psi), Seal Time = 1 sec., Cool Time = 0.1 sec., Peel speed = 200 mm/sec, sample size = 25.4 mm (1 inch) wide.
- ▶ Seal Initiation Temperature - defined as seal temperature where a 8.8 Newton seal strength is achieved.

TOPAS Blends Ultimate Seal Strength



Improved Ultimate Seal Strength with 8007 COC blended with LLDPE

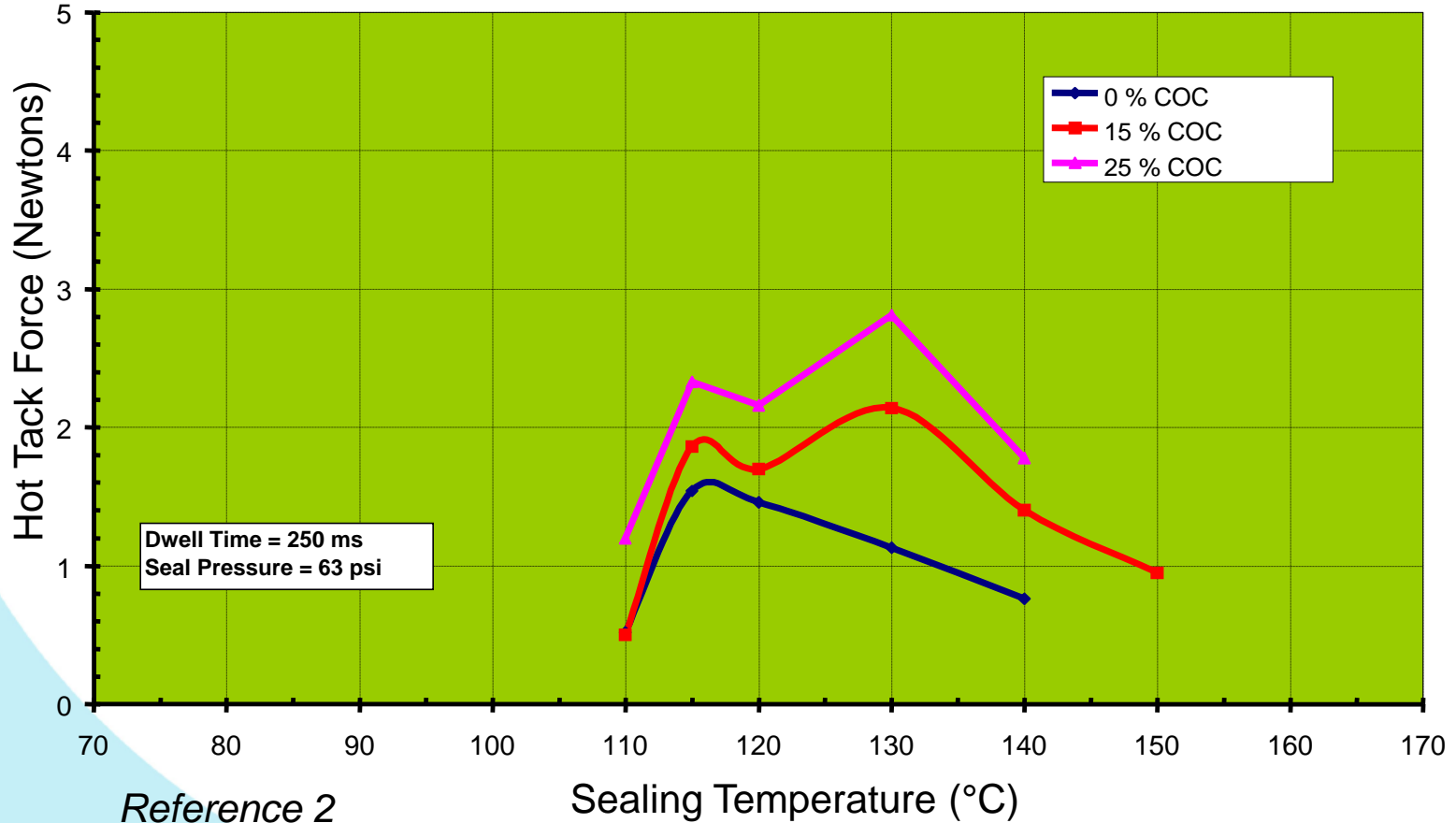


COC blends produce a wider sealing window

TOPAS Blends Hot Tack Force

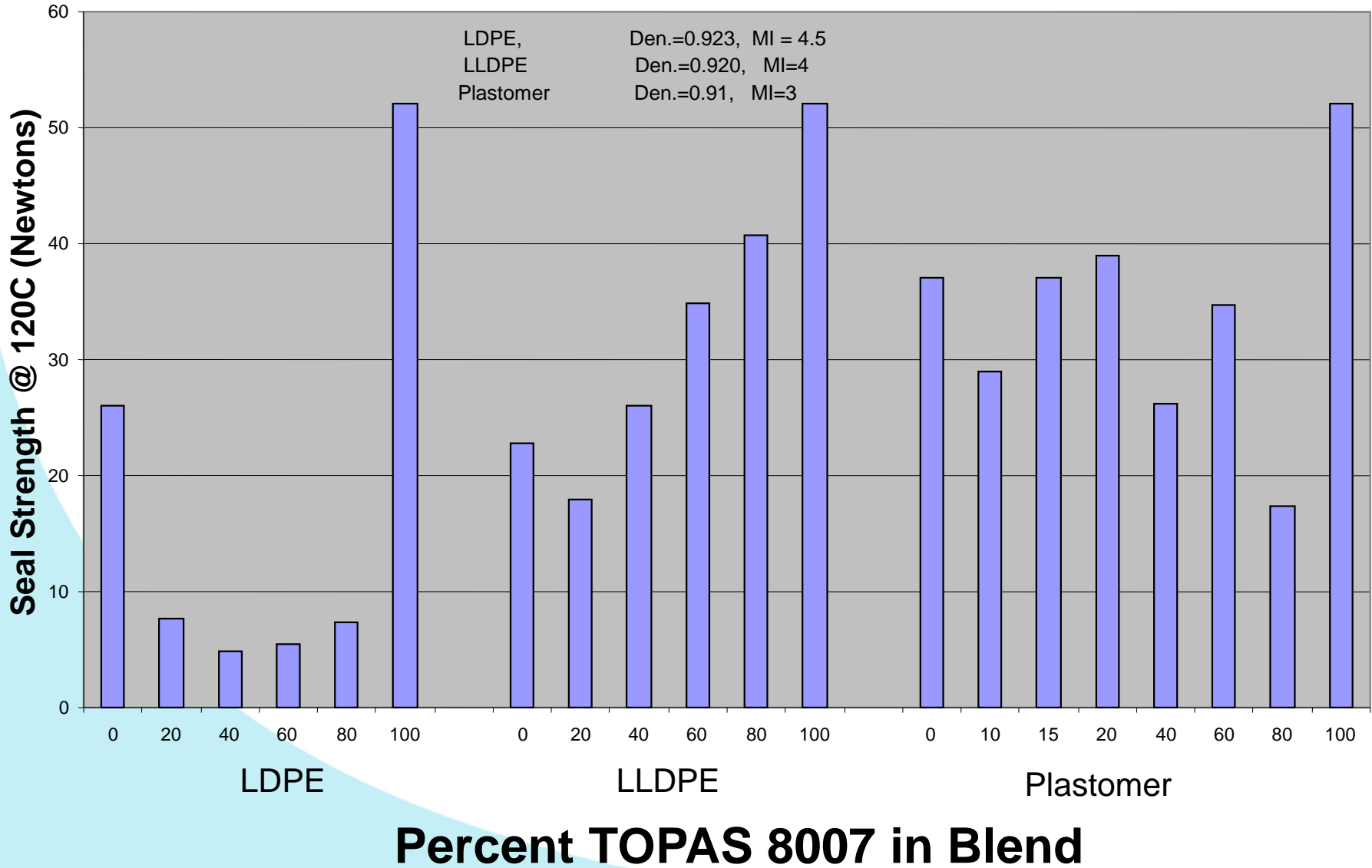


Effect of Blending TOPAS 8007 COC with LLDPE on Hot Tack Force

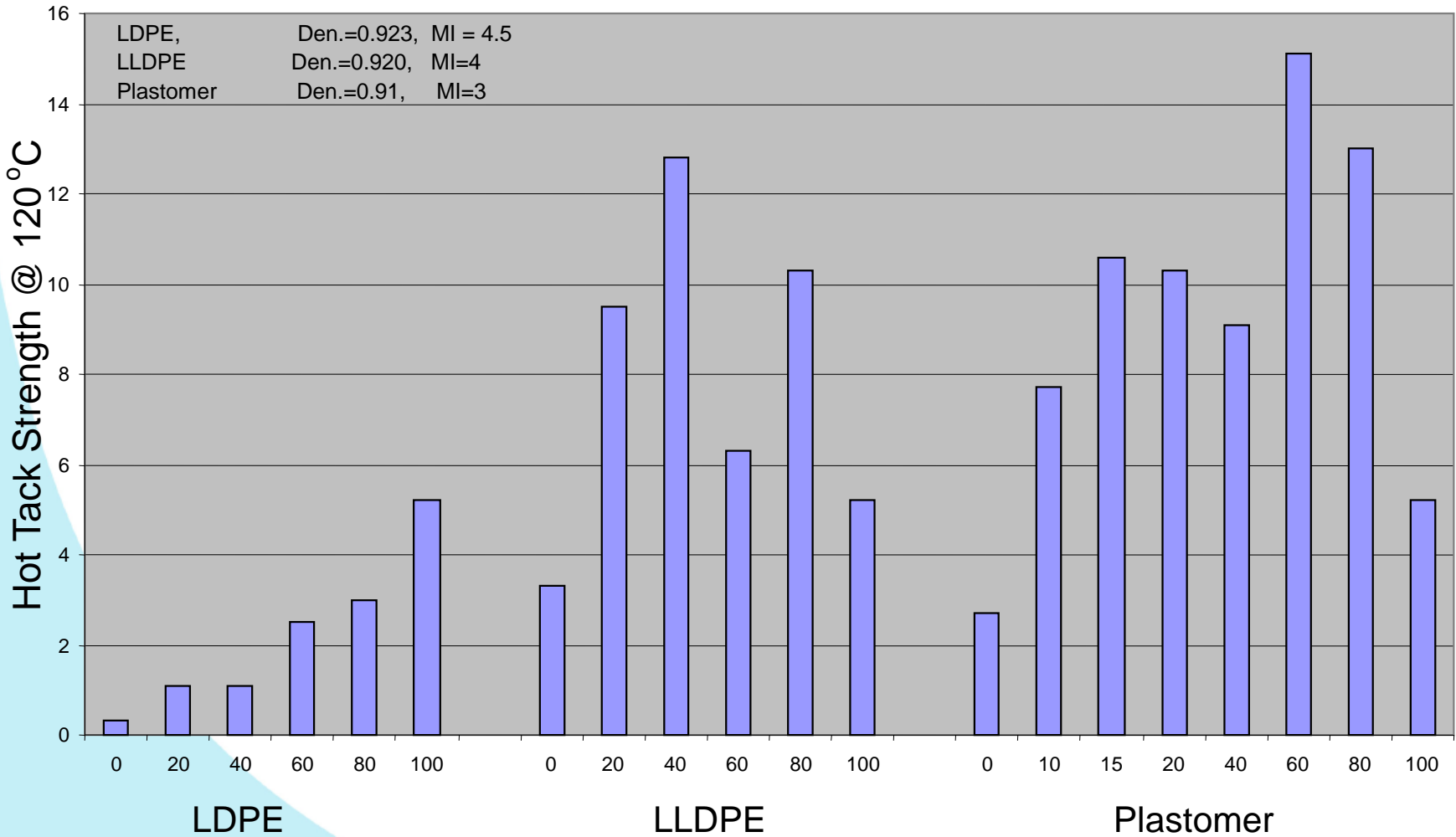


COC blends produce a wider sealing window

Effect of COC Addition on Seal Strength



Effect of COC Addition on Hot-Tack



Percent TOPAS 8007 in Blend

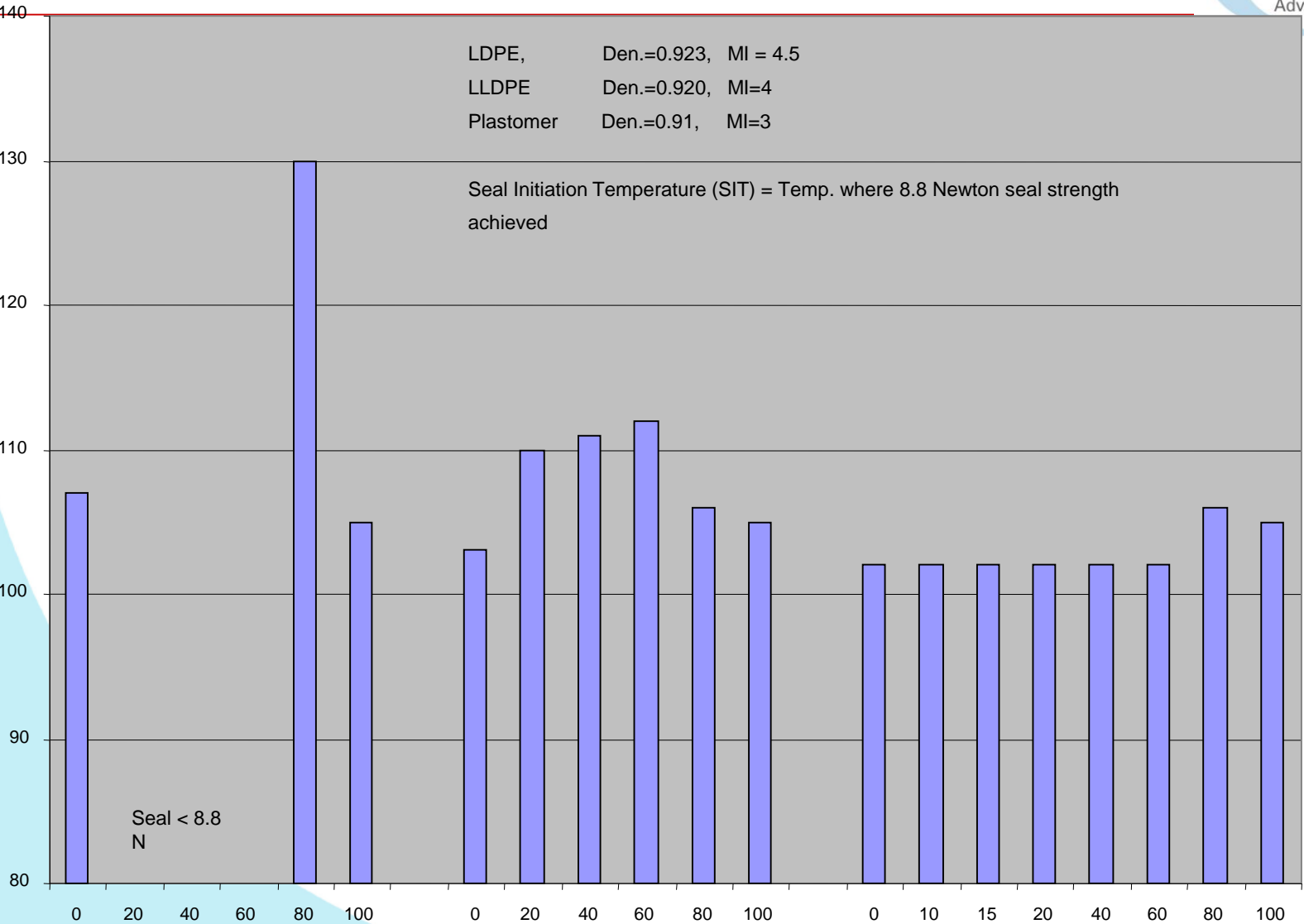
Effect of TOPAS 8007 Addition on SIT



LDPE, Den.=0.923, MI = 4.5
 LLDPE Den.=0.920, MI=4
 Plastomer Den.=0.91, MI=3

Seal Initiation Temperature (SIT) = Temp. where 8.8 Newton seal strength achieved

Seal initiation Temperature (°C)



LDPE

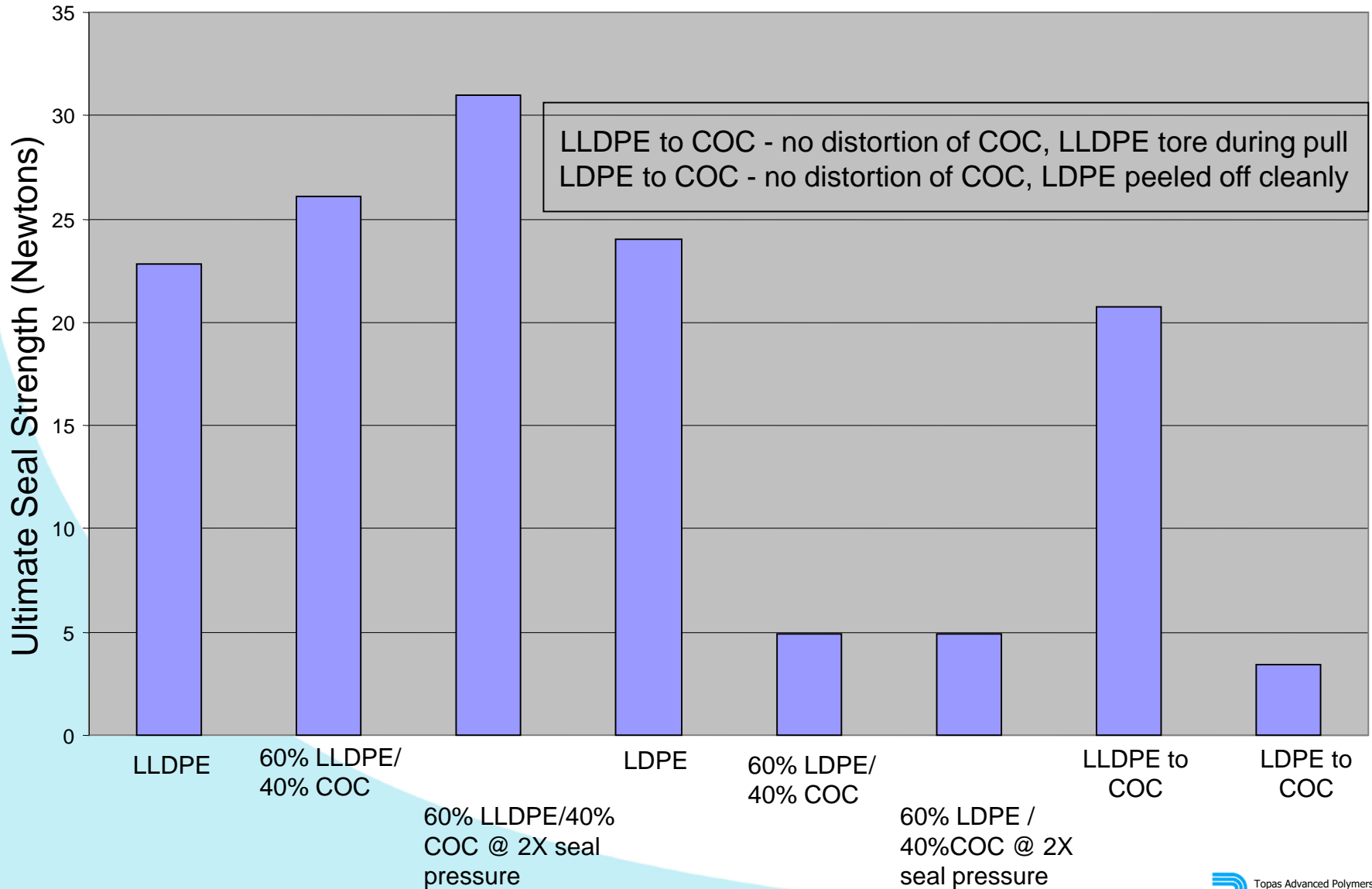
LLDPE

Plastomer

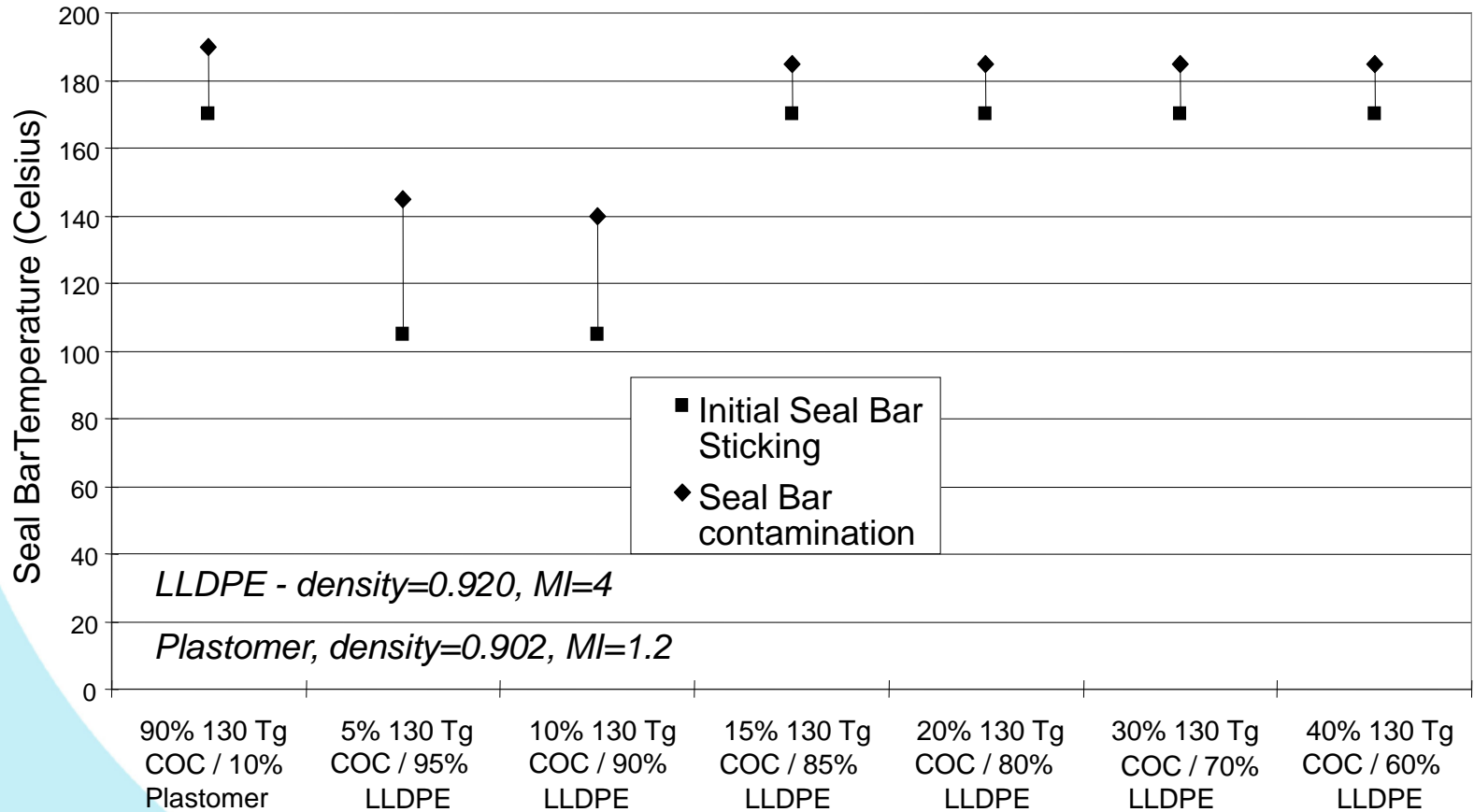
Percent TOPAS 8007

Seal < 8.8 N

Seal Strength at 120°C of LDPE vs. LLDPE



Seal Through Test Results



High Tg COC as an outer layer blend component can provide seal through capability

Conclusions

- ▶ **COC/polyethylene blends can exhibit both improved modulus and heat seal performance**
- ▶ **COC is more compatible with LLDPE and Plastomers than LDPE**
- ▶ **COC level and matrix polymer affect heat seal performance**
 - ▶ **8007 COC generally improves hot tack strength at all blend levels for the polyethylene systems studied.**
 - ▶ **8007 COC reduced the seal strength of LDPE at concentrations of 20% and up while maintaining or improving the seal strength of LLDPE and Plastomer**
- **130° Tg COC blended at levels above 20% can provide “seal through” capability to polyethylenes**

References



1. *ASTM, Designation: F 1921-98, Standard Test Methods for Hot Seal Strength (Hot Tack) of Thermoplastic Polymers and Blends Comprising the Sealing Surfaces of Flexible Webs, ASTM Standards 1999*
2. *R.R. Lamonte, "Stiffer, Thinner, Packaging Films with Improved Sealing Using Cyclic Olefin Copolymers", Flexpac Conference, Amsterdam, Holland, November 2000*
3. *D.R. Constant, "Cyclic-Olefinic Copolymers as Non-Migrating Polymeric Slip Additives in LDPE Cast Films", ANTEC 2002 Conference, San Francisco, CA*