Eastman additives for TPEs (SBC) compounding

One of the major challenges in compounding TPEs (thermoplastic elastomers) such as styrenic block copolymers (SBCs) is optimizing physical and mechanical properties while maintaining favorable rheological properties for processing. Often, formulators are faced with "trade-offs" between properties and economics, compression and cost, and toughness and moldability.

To help eliminate these challenges and trade-offs, Eastman's pure monomer-based resins (PMRs) are specifically engineered to provide the necessary rheology control while providing the optimum physical and mechanical properties for specific applications.

The benefits of switching to Eastman PMRs in compounds based on SBCs, specifically on styrene ethylenebutylene styrene (SEBS) include:

- **Improved processability**—better flow properties without losing mechanical properties
- **Improved mechanical properties**—higher tensile and tear strengths
- **Hardness control**—the ability to maintain the control hardness based on resin selection

Table 1

Eastman pure monomer resins (PMRs)

	Kristalex™ hydrocarbon resin 3070	Kristalex™ hydrocarbon resin 3085	Kristalex™ hydrocarbon resin 3100	Kristalex™ hydrocarbon resin 5140	Piccolastic™ hydrocarbon resin D125	Endex™ hydrocarbon resin 155
R&B[a] SP, °C	70	85	100	139	125	155
T_g, °C	32	41	53	85	64	99
M_z	1450	1900	2250	12100	179000	13850
M_w	950	1150	1500	2800	37400	6950
M_n	650	650	700	800	1300	2400
P_d	1.5	1.8	2.1	3.5	28.5	3.0

[a] *R&B SP—Ring and Ball Softening Point*

Morphological changes

Addition of PMRs into a SEBS polymer helps control the morphology to obtain the best performance. Due to the specific chemistry of these resins, they migrate to the polystyrene phase of the SEBS, which helps improve the mechanical properties as well as the processability of SEBS-based TPEs. Figure 1 shows the change in morphology of SEBS polymer with the addition of Eastman pure monomer resins. (The formulation used for this study is detailed in Table 2.)

Table 2
Study formulation

Kraton™ G1651	15%–20%
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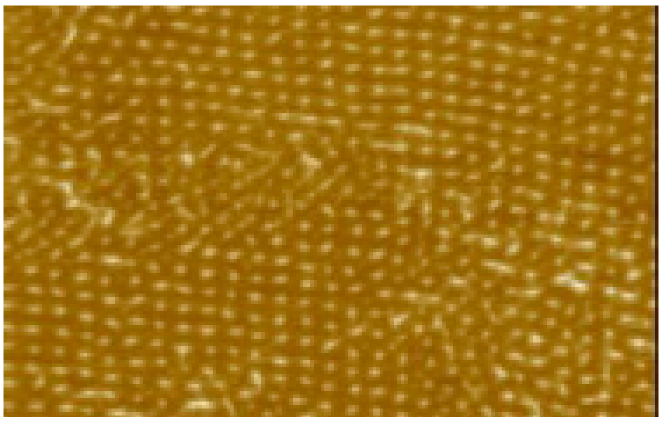
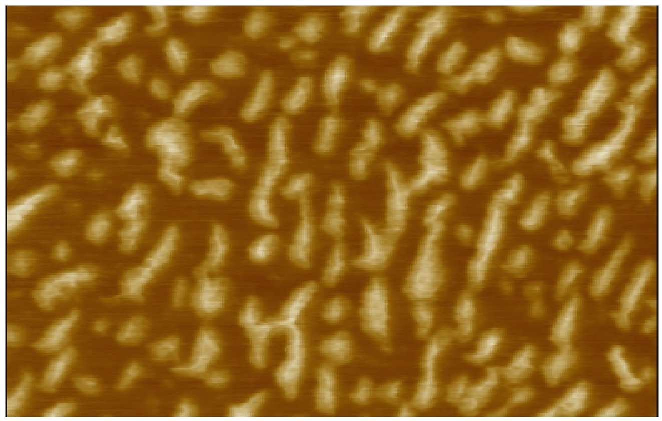
Drakeol™ 34 oil	25%–30%
$CaCO_3$	10%–15%
ExxonMobil™ polypropylene resin PP3155	10%–15%
Eastman resin	0%–10%

Figure 1
SEBS morphology with 10% pure monomer resin (Kristalex™ hydrocarbon resin 5140)



0 Data type Z range Phase 30.0 de 1.00 μM

SEBS morphology—control



0 Data type Z range Phase 60.0 de 1.00 μM

SEBS morphology—with 10% Kristalex 5140

Physical and mechanical properties

Figure 2 shows the change in hardness with the addition of PMRs. Migration of PMRs to the polystyrene phase leads to further reinforcement, which raises the hardness of the overall formulation.

Figure 2

Hardness (Shore A) of TPE compounds with PMRs

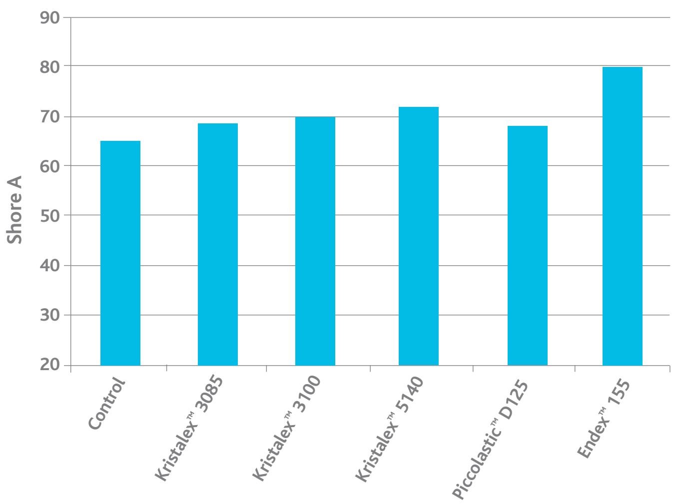


Figure 3 shows the effect of PMRs on tensile strength. All PMRs significantly increase the tensile strength of the studied SEBS-based formulation. This is mainly due to the reinforcing effect and the overall increase in the volume fraction of the styrene phase. However, the 300% modulus data given in Figure 4 shows that higher molecular weight resins exhibit significant increase in modulus. Thus, Eastman's broad resin portfolio helps one to tailor SEBS-based formulations for specific applications.

Figure 3

Tensile strength (psi) of TPE compounds with PMRs

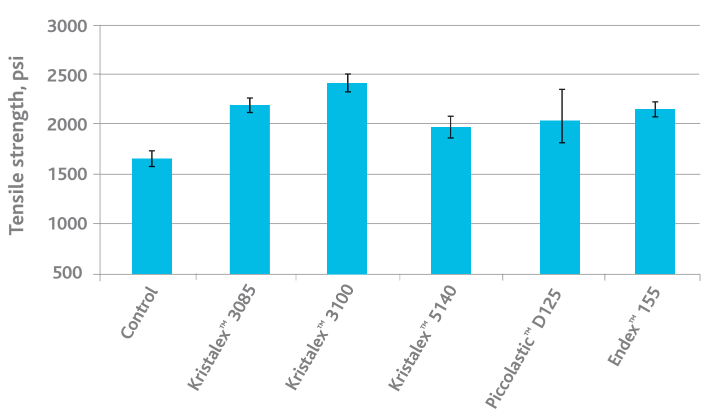


Figure 4

300% Modulus (psi) of TPE compounds with PMRs

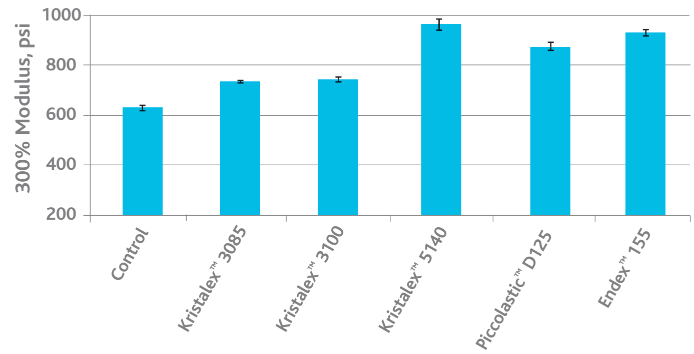
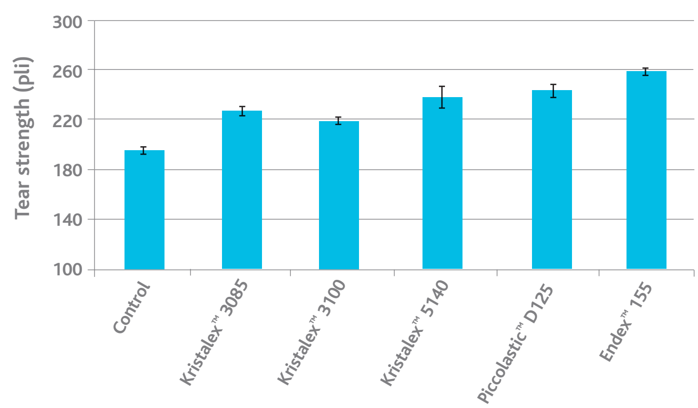


Figure 5 shows change in tear strength with addition of PMRs. All PMRs have a positive impact on tear strength. This can be directly attributed to the reinforcement of the styrene phase.

Figure 5

Tear strength (pli) of TPE compounds with PMRs

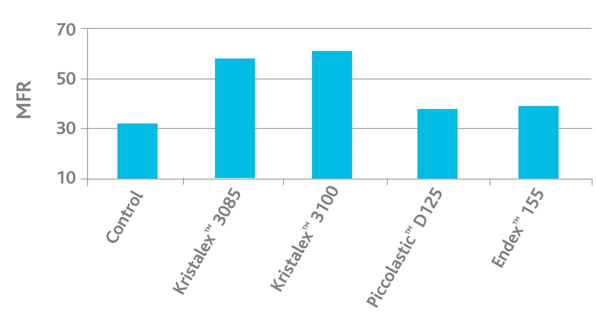


Melt flow index

Addition of resins substantially increases the melt flow of SEBS-based TPEs. Lower molecular weight PMRs show the most significant increase in melt flow index (MFI).

Figure 6

Melt flow rate of TPE compounds with PMRs



TPE applications

Thermoplastic elastomers are used in a variety of applications, including—among many others—the following:

- Athletic shoe soles
- Automotive boots
- Automotive ducting
- Automotive and industrial hosing
- Automotive interiors
- Caster wheel treads
- Closures
- Cosmetics packaging
- Construction seals
- Conveyor belting
- Dishwasher boots and seals
- Films
- Flexible extruded parts
- Food contact diaphragms
- Food storage
- Kitchenware grips
- Moldable gels
- Plumbing gaskets
- Softer oil-resistant grips
- Solar collector seals
- Toothbrush and razor soft grips
- Tubing
- Wire and cable insulation

Summary

The use of Eastman pure monomer resins in SEBS-based TPE compounds improves processability, increases tensile and tear strength, and has minimal impact on a compound's hardness.

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