Advantages of using Eastman TXIB™ formulation additive in polyurethane elastomers

Polyurethane elastomers are used in applications ranging from gaskets and tubing to skateboard wheels and rollers. Requirements related to performance of polyurethane (PU) elastomers in these various applications include hardness (durometer) and mechanical properties such as tensile strength and compression set. Issues related to production of PU elastomers include viscosity, cost, and water content of raw materials. Formulators of PU elastomers use a variety of additives to address these performance requirements and production issues.

Eastman TXIB provides the PU elastomer formulator a means to:

- Efficiently lower viscosity of prepolymers and therefore lower system viscosity
- Extend the PU system with little or no effect on physical properties, lowering the total overall cost
- Increase the volume of the system, allowing the purchase of fewer pounds of raw material to produce the same number of parts

Technical discussion

PU elastomers can comprise multiple polymer types, including polyether and polyester polyols in combination with MDI and TDI isocyanates and various diol and diamine cross-linkers.

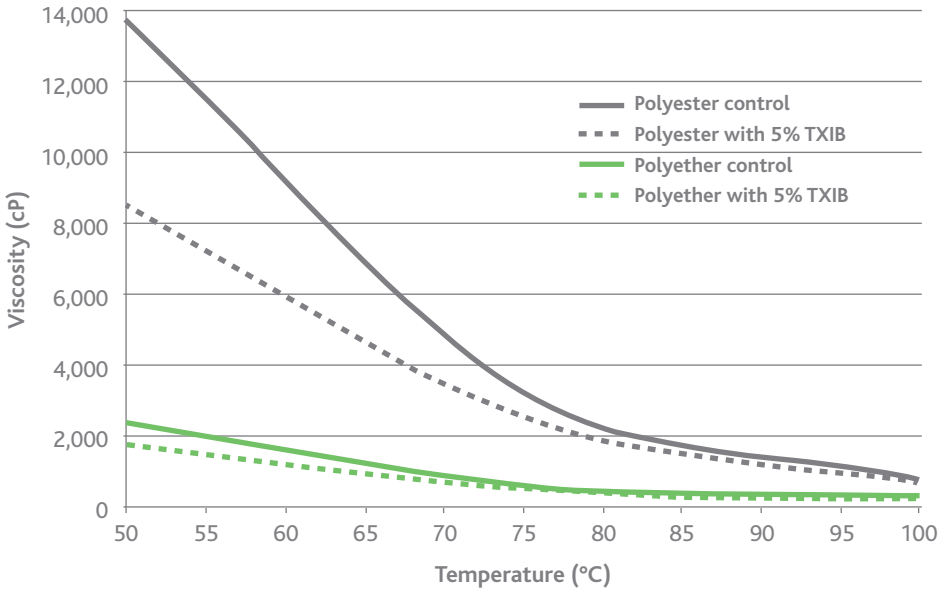
Multiple polyurethane elastomers were formulated using Eastman TXIB in various chemical systems; the formulations are shown in Table 1 and represent a constant isocyanate index of 1.05. The viscosity, hardness, and physical properties were measured for each system.

Table 1 Elastomer formulations (wt%)

Raw material	Polyether control	Polyether with 5% TXIB	Polyester control	Polyester with 5% TXIB
Vibrathane® B601[a] (TDI polyether)	86.7	82.3	–	–
Vibrathane 6012[a] (MDI polyester)	–	–	93.2	88.5
Eastman TXIB	–	5.0	–	5.0
Ethacure® 300[b]	13.3	12.7	–	–
1,4-butanediol	–	–	6.8	6.5

[a]*Chemtura Corporation*
[b]*Albermarie Corporation*

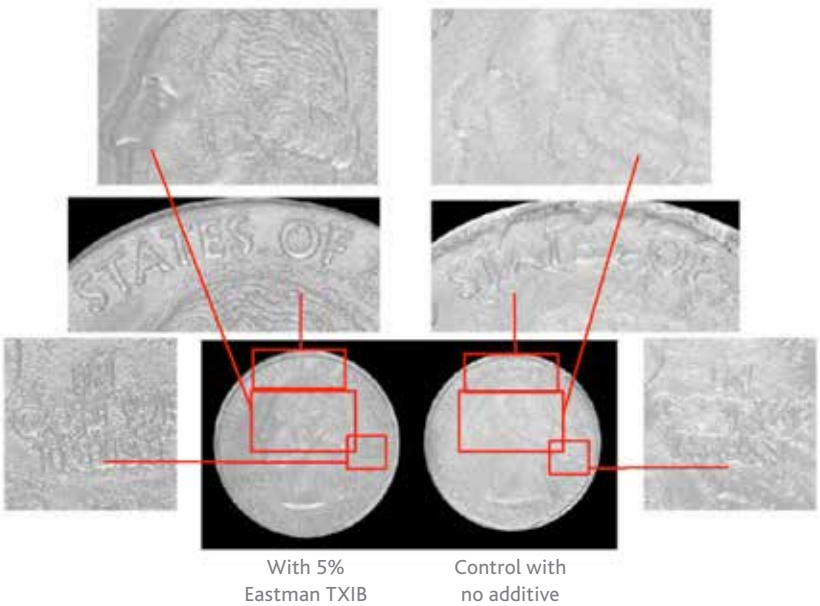
Figure 1 Viscosity of polyether and polyester elastomer systems with addition of Eastman TXIB



Eastman TXIB reduces system viscosity.

Figure 1 illustrates the viscosity reduction performance of Eastman TXIB at a 5% addition rate. At the 5% addition level, there is a 27% viscosity reduction in the polyester system at 50°C and a 38% viscosity reduction in the polyether system at 50°C. Due to the unique structure of Eastman TXIB and its own low viscosity (9 cP @ 25°C), it is very efficient at reducing the overall viscosity of polyurethane elastomer systems.

Figure 2 Increased moldability of a polyurethane elastomer system with addition of Eastman TXIB



Eastman TXIB increases moldability.

The superior moldability Eastman TXIB brings to an elastomer system is demonstrated in Figure 2 by the improved definition highlighted in the three sections of the quarter.

Eastman TXIB extends without degrading properties.

Eastman TXIB is an excellent extender for polyurethane elastomer systems because it has little effect on the physical properties of the elastomer system. A complete outline of the physical properties for all systems can be seen in Table 2.

Table 2 Physical property data for polyether and polyester systems with the addition of Eastman TXIB

Test	Polyether control[a]	Polyether with 5% TXIB[a]	Polyester control[a]	Polyester with 5% TXIB[a]
Specific gravity	1.110 (0.002)	1.105 (0.003)	1.202 (0.004)	1.190 (0.002)
Hardness (Shore A)	95 (1)	93 (1)	94 (1)	91 (1)
Tensile strength	35.7 (3.5)	28.1 (3.8)	28.1 (2.8)	24.7 (9.6)
Modulus at 100% (MPa)	13.1 (0.1)	11.4 (0.1)	8.35 (0.26)	7.69 (0.52)
Tear strength (N)	164 (22)	158 (15)	194 (19)	154 (34)
Tear resistance (kN/m)	82.9 (12)	79.8 (7.7)	97.6 (5.4)	80.1 (17.3)
Compression set (%)	56.2 (0.5)	56.0 (0.7)	77.9 (0.9)	88.7 (1.2)
Bashore resilience (%)	49.2 (0.8)	47.3 (0.4)	42.1 (0.1)	44.1 (0.2)

[a]*Standard deviation in parentheses*

The specific gravity of Eastman TXIB is lower than the specific gravity of the prepolymer and curative, so its addition lowers the overall specific gravity of the system. Thus for a given system weight, the addition of Eastman TXIB increases the overall volume of the system.

To demonstrate the increased system volume that could be generated with the addition of Eastman TXIB, consider as an example the production of elastomeric rollers. Assume a company applies 1 million pounds of elastomer annually as a 1-inch-thick sheath around a 4-foot-long, 4-inch-diameter metal core. Table 3 shows the number of rollers the company could theoretically manufacture using the polyether and polyester formulations with the specific gravities given in Table 2. It then considers the number of additional rollers the company could manufacture with the same weight of mix containing 5% and 10% of Eastman TXIB.

Table 3 Additional product produced with the addition of Eastman TXIB

	Control	With 5% TXIB	With 10% TXIB
Polyether TDI	33,204 parts	+120 additional parts/year	+424 additional parts/year
Polyester MDI	30,635 parts	+298 additional parts/year	+608 additional parts/year

The addition of Eastman TXIB to polyurethane elastomer systems provides many benefits. At a level of 5%, there is significant lowering of viscosity with minimal effect on physical properties. In addition, the overall system volume increases, allowing the polyurethane manufacturer to produce more parts from the same weight of raw material.

For more information on advantages of using Eastman TXIB™ formulation additive, call your Eastman representative today or visit www.EastmanPlasticizers.com.

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