Eastman TXIB Formulation Additive

for Vinyl Plastisols

EASTMAN

Contents

Introduction

Eastman TXIB formulation additive is a superior primary plasticizer for PVC plastisols. It has good compatibility with polyvinyl chloride (PVC), and it is compatible with all common primary and secondary plasticizers. *Eastman TXIB* formulation additive provides low viscosity characteristics in plastisols with good viscosity stability over time.

Figure 1

Structure of *Eastman TXIB* Formulation Additive
CAS No. 6846-50-0

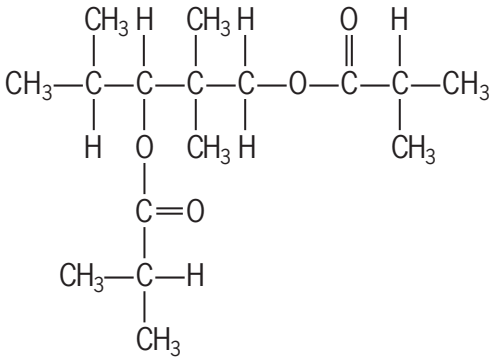


Table 1

Typical Properties of *Eastman TXIB* Formulation Additive[a]

General	
Molecular Weight (Theoretical)	286.4
Empirical Formula	$C_{16}H_{30}O_4$
Physical	
Form	Liquid
Color, APHA ppm	30 max.
Appearance	Free from insoluble matter and haze
Purity, % by weight	98 min.
Acidity, as isobutyric acid, % by weight	0.05 max.
Refractive index, n25°C/D	1.430
Specific Gravity @ 20°C/20°C	0.942–0.948
Wt/Vol @ 20°C (68°F)	
lb/gal (U.S.)	7.86
kg/L	0.94
lb/gal (Imperial)	9.43
Boiling Point @ 760 mm, °C (°F)	281.5 (538.7)
Freezing Point, °C (°F)	−70 (−94)
Solubility in Water @ 20°C, g/L	0.42
Evaporation Rate @ 100°C (g/1,000 cm^2)/h	0.674
Flash Point, *Pensky-Martens* Closed Cup, °C (°F)	128 (262)
Fire Point, *Cleveland* Open Cup, °C (°F)	152 (305)
Autoignition temperature, °C (°F)	424 (795)
Brookfield viscosity on No. 1 spindle @ 25°C, cP	9
Stability	
Boiling Water Stability (% hydrolyzed after 96h)	0.003
Electrical	
Volume Resistivity, ohm-cm (ASTM D257)	1.5×10^{11}
Dielectric Constant @ 1 MHz (ASTM D150)	4.5
Dissipation Factor @ 1 MHz (ASTM D150)	0.13×10^{-2}

[a]*Properties are reported for information only. Eastman makes no representation that the material in any particular shipment will conform exactly to the values given.*

Performance Properties Imparted by *Eastman TXIB* Formulation Additive

In flexible vinyl, *Eastman TXIB* formulation additive is similar in plasticizing efficiency to many general purpose plasticizers, including *Eastman* 168 plasticizer (DOTP) and DINP. Other similarities include:

- Tensile Strength
- Ultimate Elongation
- Tear Resistance
- Brittleness Temperature

Table 2 compares the performance of plastisols with blends of *Eastman TXIB* and *Eastman* 168 to a plastisol with only *Eastman* 168. Additionally, Table 3 shows similar performance data for blends of *Eastman TXIB* and *Jayflex* DINP in a plastisol.

Table 2

Performance of *Eastman TXIB* Formulation Additive/*Eastman* 168 Plasticizer Blends in Typical PVC Plastisols

	Parts per Hundred Resin (phr)		
Formulation			
Oxy 654 PVC Dispersion Resin[a]	100	100	100
Eastman 168 Plasticizer[b]	50	45	40
Eastman TXIB Formulation Additive[b]	—	5	10
Ba, Zn Heat Stabilizer[c]	3	3	3
Plasticizer Concentration	50	50	50
Mechanical Properties			
Tensile Strength, psi (MPa)	2,520 (17.4)	2,540 (17.5)	2,610 (18.0)
Ultimate Elongation, %	336	327	341
Tear Resistance, ppi (kN/m)	384 (67.3)	373 (65.2)	356 (62.4)
Efficiency			
100% Modulus, psi (MPa)	1,280 (8.8)	1,300 (9)	1,380 (9.5)
Shore A Durometer Hardness	81	78	80
Permanence			
1% Soap Solution Extraction, loss %	0.3	0.5	0.6
Hexane Extraction, loss %	34	26	24
Cottonseed Oil Extraction, loss %	6.4	5	3.8
Activated Carbon Extraction, loss %	1.3	2.5	3.6
Low Temperature Flexibility			
Brittleness Temperature, °C	−34	−34	−35

[a]*Occidental Chemical*
[b]*Eastman Chemical Company*
[c]*Akzo Nobel*

Table 3

Performance of *Eastman TXIB* Formulation Additive/*Jayflex* DINP Plasticizer Blends in Typical PVC Plastisols

	Parts per Hundred Resin (phr)		
Formulation			
Oxy 654 PVC Dispersion Resin[a]	100	100	100
Jayflex DINP Plasticizer[b]	50	45	40
Eastman TXIB Formulation Additive[c]	—	5	10
Ba, Zn Heat Stabilizer[d]	3	3	3
Plasticizer Concentration	50	50	50
Mechanical Properties			
Tensile Strength, psi (MPa)	2,490 (17.2)	2,410 (16.6)	2,350 (16.2)
Ultimate Elongation, %	319	308	296
Tear Resistance, ppi (kN/m)	385 (67.6)	391 (68.5)	385 (67.6)
Efficiency			
100% Modulus, psi (MPa)	1,410 (9.7)	1,380 (9.5)	1,350 (9.3)
Shore A Durometer Hardness	80	80	80
Permanence			
1% Soap Solution Extraction, loss %	0.5	0.8	0.9
Hexane Extraction, loss %	26	24	22
Cottonseed Oil Extraction, loss %	5.3	4.1	3.7
Activated Carbon Extraction, loss %	1.4	3	4
Low Temperature Flexibility			
Brittleness Temperature, °C	−30	−30	−28

[a]*Occidental Chemical*
[b]*ExxonMobil Chemical*
[c]*Eastman Chemical Company*
[d]*Akzo Nobel*

Plastisol Viscosity

Adding *Eastman TXIB* formulation additive to plastisol formulations lowers overall plastisol viscosity and improves viscosity stability over time. The lower viscosity improves handling characteristics, making pumping and pouring of the plastisol easier. Additionally, the lower viscosity can allow for improved flow into small mold cavities. The addition of *Eastman TXIB* formulation additive also permits the use of higher amounts of filler which can be an economical benefit. Figures 2 and 3 show plastisol viscosities from the formulations in Tables 2 and 3.

Figure 2

Brookfield Viscosity (cP) vs. Time
(*Eastman TXIB* Formulation Additive With *Eastman* 168 Plasticizer)

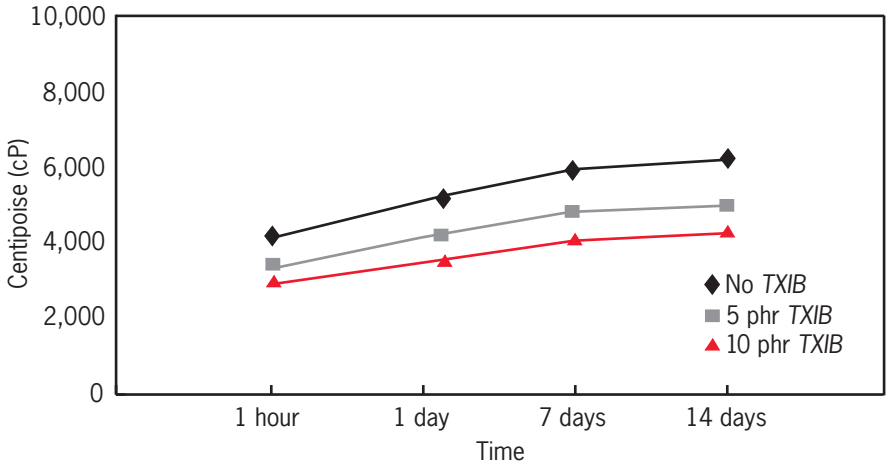
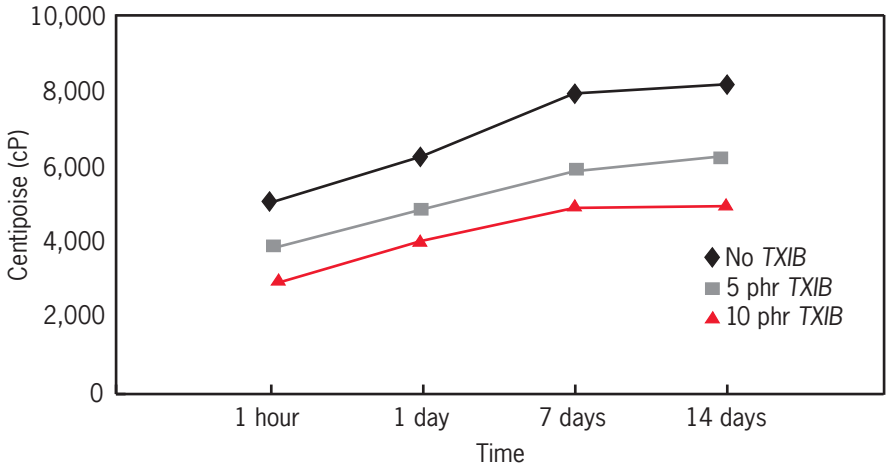


Figure 3

Brookfield Viscosity (cP) vs. Time
(*Eastman TXIB* Formulation Additive With *Jayflex* DINP)

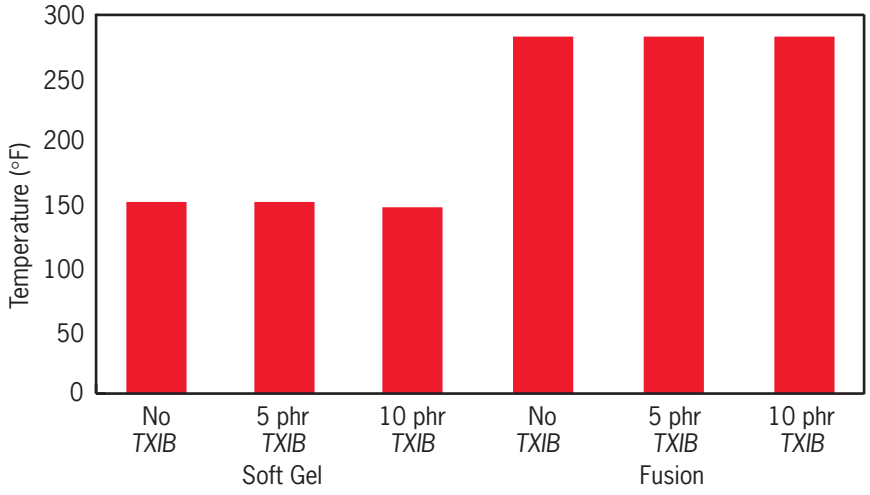


Gelation and Fusion Properties

The addition of *Eastman TXIB* formulation additive to plastisols has minimal effect on the gelation and fusion characteristics of the formulation. Figure 4 shows the gelation and fusion temperature of the formulations outlined in Table 2 (*Eastman* 168 plasticizer and *Eastman TXIB* formulation additive). The added *Eastman TXIB* formulation additive has minimal effect on these properties.

Figure 4

Gelation and Fusion Properties of Plastisols



Stain Resistance

Finished vinyl articles formulated with *Eastman TXIB* formulation additive offer increased stain resistance and less surface tackiness. These articles include children's toys and sheeting for flooring. The vinyl flooring industry has realized the advantage of using plasticizer systems with soil- and stain-resisting qualities to help prolong the attractive appearance of flooring during normal use. For example, 6 years of testing a heavy-traffic office area showed that vinyl tile processed with plasticizer blends containing *Eastman TXIB* formulation additive typically outperformed tile containing phthalate plasticizers alone. Laboratory studies have shown that vinyl samples made with 10 phr of *Eastman TXIB* formulation additive (in addition to 40 phr of *Eastman* 168) showed improved stain resistance to mustard, brown shoe polish, and black felt pen compared to 50 phr of *Eastman* 168 alone.

Using *Eastman TXIB* Formulation Additive to Lower Plastisol Formulation Costs

Manufacturers of PVC plastisols are constantly looking for ways to reduce costs. A common way to reduce formulation cost is the addition of filler, primarily calcium carbonate. However, the addition of filler can increase the plastisol's viscosity above that which is desired for proper processing. *Eastman TXIB* formulation additive can significantly lower the viscosity of the plastisol when substituted for a portion of the primary plasticizer. Thus, the addition of filler along with the correct amount of *Eastman TXIB* formulation additive can reduce the overall formulation cost while holding the viscosity to the desired level. Figure 5 shows the amount of filler needed to maintain equivalent viscosity (using the formulations from Table 2).

The substitution of some general purpose plasticizer with *Eastman TXIB* formulation additive along with the addition of filler can provide a lower plastisol formulation cost. This is shown in Table 4, where three formulations (with equivalent viscosities) show improvement in unit cost per pound of plastisol as the substitution of *Eastman TXIB* formulation additive and addition of filler are both increased. These three formulations were generated from data points taken off the curve in Figure 5.

Figure 5

Eastman TXIB Formulation Additive: Filler Ratios Needed to Maintain Equivalent Viscosity

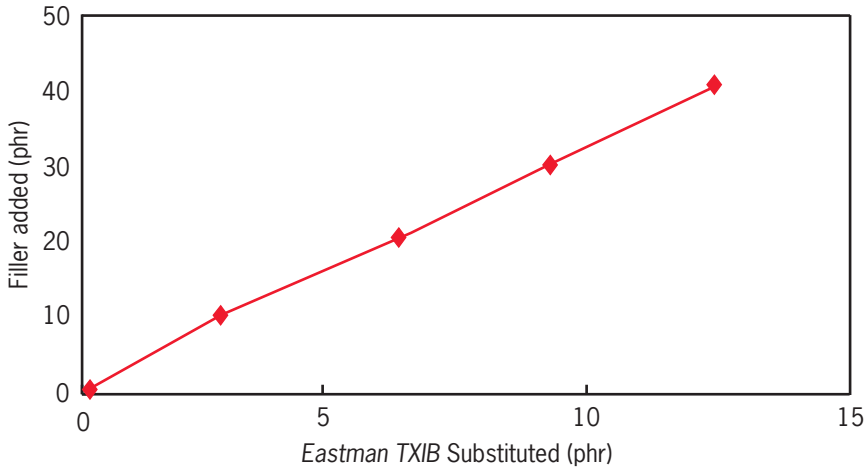


Table 4

Plastisol Formulation Costs

Material	Unit Cost/ Lb.	Formulation 1		Formulation 2		Formulation 3	
		Lbs.	Cost	Lbs.	Cost	Lbs.	Cost
PVC Resin	1	100	100	100	100	100	100
General Purpose Plasticizer	1	50	50	44	44	38	38
Heat Stabilizer	2.5	3	7.5	3	7.5	3	7.5
Eastman TXIB Formulation Additive	1	0	0	6	6	12	12
Filler	0.08	0	0	20	1.6	40	3.2
Total Weight		153		173		193	
Total Cost		157.5		159.1		160.7	
Cost/lb. Formula		**1.03**		**0.92**		**0.83**	

To speak with a representative
or for more information on
Eastman TXIB formulation additive,
call 1-800-Eastman or
visit www.eastman.com.

EASTMAN

Eastman Chemical Company
Corporate Headquarters
P.O. Box 431
Kingsport, TN 37662-5280 U.S.A.

Telephone:
U.S.A. and Canada, 800.EASTMAN (800.327.8626)
Other Locations, (1) 423.229.2000
Fax: (1) 423.229.1193

www.eastman.com

Eastman Chemical Latin America
9155 South Dadeland Blvd.
Suite 1116
Miami, FL 33156 U.S.A.

Telephone: (1) 305.671.2800
Fax: (1) 305.671.2805

Eastman Chemical B.V.
Fascinatio Boulevard 602-614
2909 VA Capelle aan den IJssel
The Netherlands

Telephone: (31) 10 2402 111
Fax: (31) 10 2402 100

Eastman Chemical Japan Ltd.
AIG Aoyama Building 5F
2-11-16 Minami Aoyama
Minato-ku, Tokyo 107-0062 Japan

Telephone: (81) 3.3475.9510
Fax: (81) 3.3475.9515

Eastman Chemical Asia Pacific Pte. Ltd.
#05-04 Winsland House
3 Killiney Road
Singapore 239519

Telephone: (65) 6831.3100
Fax: (65) 6732.4930

Material Safety Data Sheets providing safety precautions, that should be observed when handling and storing Eastman products, are available online or by request. You should obtain and review the available material safety information before handling any of these products. If any materials mentioned are not Eastman products, appropriate industrial hygiene and other safety precautions recommended by their manufacturers should be observed.

Neither Eastman Chemical Company nor its marketing affiliates shall be responsible for the use of this information, or of any product, method or apparatus mentioned, and you must make your own determination of its suitability and completeness for your own use, for the protection of the environment and for the health and safety of your employees and purchasers of your products. NO WARRANTY IS MADE OF THE MERCHANTABILITY OR FITNESS OF ANY PRODUCT, AND NOTHING HEREIN WAIVES ANY OF THE SELLER'S CONDITIONS OF SALE.

Eastman and *Eastman TXIB* are trademarks of Eastman Chemical Company.

Publication L-231
May 2006
Printed in U.S.A.