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Application Bulletin– Trilene

Easy Mixing and Processing with Trilene of High Durometer Compounds

- ***Easy Processing***
- ***Maintain High Modulus***
- ***Good green Strength***
- ***Low Compression Set***

* Trilene® liquid EPDM in high durometer extrusion offers the compounder unique advantage for reducing weight and cost .
* Compared to alternative petroleum-based processing aids, Trilene® liquid polymers facilitate easy processing of highly black-loaded stocks without trading-off rigidity and flex modulus for retained grip or sealing force.

Introduction

Applications that have traditionally overmolded or co-extruded a functional component of EPDM rubber over rigid, reinforced inserts or carriers are challenged to reduce cost and weight in the final product by the elimination of metal, plastic, and wire. High durometer EPDM, in some cases, offers a much lighter, less expensive, and more easily recyclable alternative. Further, it offers additional cost advantage by eliminating adhesives and supporting lean Manufacturing.

In a typical extruded automotive weatherseal, rigid / flexible steel or woven wire is partially or completely replaced with 45 Shore D EPDM. The cured component must be quite rigid but still retain the elastic properties of flex modulus and compression set. 65 or 75 Shore A EPDM is usually co-extruded into the seals, grippers, and show surface veneer.

	A	B	C	D	E	F
Masterbatch Mix						
Keltan 1446A	100.0	---	---	---	---	---
Mitsui 4010	---	100.0	---	---	---	---
Trilene® 77	---	---	0.0	10.0	20.0	30.0
Trilene 67	---	---	---	---	---	---
Royalene® 535	---	---	70.0	60.0	50.0	40.0
Royalene 5010	---	---	30.0	30.0	30.0	30.0
N-550 Carbon Black	130.0	130.0	130.0	130.0	130.0	130.0
Calcined Clay	30.0	30.0	30.0	30.0	30.0	30.0
Sunpar 2280 Paraffinic Oil	25.0	25.0	25.0	25.0	25.0	25.0
Zinc Oxide	5.0	5.0	5.0	5.0	5.0	5.0
Stearic Acid	1.0	1.0	1.0	1.0	1.0	1.0
AC 617 Low MW Polyethylene	15.0	15.0	15.0	15.0	15.0	15.0
Royalac 136S 62	4.8	4.8	4.8	4.8	4.8	4.8
Rhenogran MBTS 75	2.0	2.0	2.0	2.0	2.0	2.0
Rhenogran ZBEC 70	1.1	1.1	1.1	1.1	1.1	1.1
Sulfur	0.8	0.8	0.8	0.8	0.8	0.8
Total	314.7	314.7	314.7	314.7	314.7	314.7

The Challenge

For black-loaded high durometer extrusion compounds the formulation must avoid, as much as possible, the use of common industry plasticizers in order to minimize trading-off desired compound modulus and compression set for processability. As a result, the compounds are very difficult to process in mixing, milling, and extrusion.

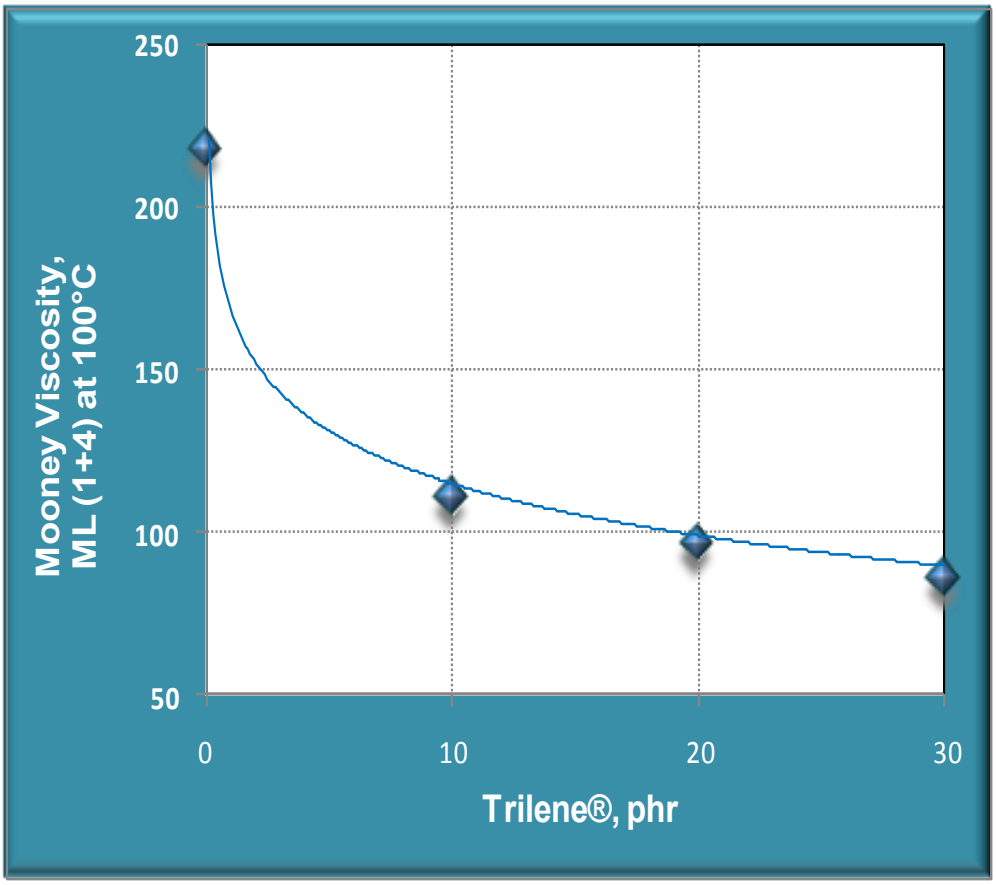
Compounders have developed solutions to this by formulating with very low Mooney solid polymers to offset the viscosity from high structure blacks required for high durometer. Used as a single polymer, however, the very low Mooney grades may lack the green strength to maintain profile in hot air continuous curing. Consequently, in most cases, they must be used as major components in blends with higher Mooney, high ENB grades.

	A	B	C	D	E	F
Polymer properties (Composites calculated)						
Mooney	**10.0**	**5.0**	**43.0**	**39.0**	**36.0**	**33.0**
E/P	**59/41**	**64/36**	**66/34**	**66/34**	**67/33**	**69/31**
ENB	**7.0**	**7.6**	**7.8**	**8.0**	**8.2**	**8.3**
MW	**1.3**	**1.4**	**4.3**	**3.9**	**3.4**	**3.0**
Relative Cost	**2.0**	**2.0**	**1.2**	**1.6**	**2.0**	**2.3**

The Solution

Trilene® liquid EPDM, used as reactive plasticizer in high durometer EPDM will produce easily processible compounds without any significant loss of hardness, low temperature flexibility, heat aging, ozone resistance, weatherability or compression set = retained sealing force. Because Trilene® liquid polymers are curable, they are non-extractable and nonvolatile after cure.

The addition of Trilene lowers viscosity to allow easy extrusion of this high hardness compound.



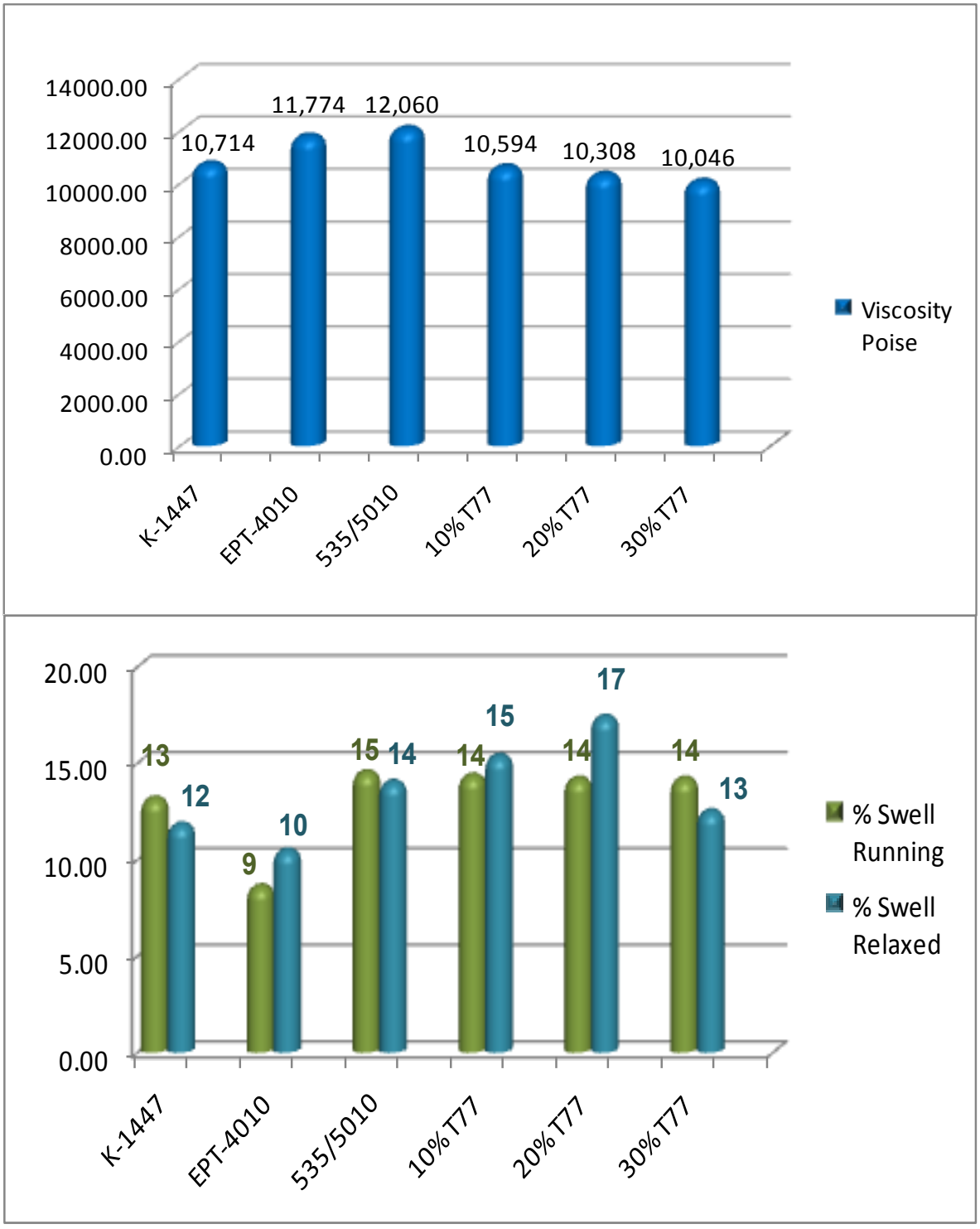
Detailed technical reports are available on request. We also encourage you to contact us with any questions that you may have on Royalene, Trilene, or blends for specific applications. Our technical business support personnel are committed to serving your needs and can be reached at 225 267-3660 or check out our website at www.lioncopolymer.com.

Polymer / Blend	K-1446	EPT 4010	70/30 R-535/5010	60/30/10 R535/5010/T77	50/30/20 R535/5010/T77	40/30/30 R535/5010/T77
Mooney						
ML 1+4 at 100 °C	87.5	68.1	218.0	110.8	96.6	85.70
Scorch						
Ts3 @125C	8.01	10.32	8.17	7.92	8.57	8.24
Min vis @ 125C	35.0	27.2	65.4	47.3	40.4	37.10
Rheometer MDR at 177ºC (ºF)						
ML, dN-m	2.1	2.0	7.1	4.3	3.3	2.5
(in-lb)	(1.9)	(1.7)	(6.3)	(3.8)	(3.0)	(2.2)
MH, dN-m	23.8	20.4	28.5	25.6	21.2	18.3
(in-lb)	(21.1)	(18.1)	(25.2)	(22.7)	(18.8)	(16.2)
ts2, minutes	0.6	0.7	0.6	0.5	0.6	0.6
t'c90, minutes	3.4	3.5	3.7	3.3	3.0	2.9
Physical Properties - Original						
Hardness, Shore A	95	95	96	93	94	94
Shore D	32	32	35	32	32	32
100% Modulus, MPa	6.1	5.7	7.5	7.3	6.9	6.4
(psi)	(890)	(825)	(1090)	(1055)	(1000)	(930)
Tensile Strength, MPa	9.2	8.1	8.3	11.5	10.8	9.7
(psi)	(1340)	(1170)	(1200)	(1670)	(1565)	(1410)
Elongation at Break, %	230	235	125	255	235	260
Tear Strength, Die C, kN/m	30.6	28.6	29.0	34.1	30.9	30.6
(pli)	(175)	(163)	(166)	(195)	(176)	(175)
Green Strength						
25% Modulus, MPa	1.4	1.0	1.8	1.6	1.6	1.6
(psi)	(200)	(140)	(255)	(235)	(230)	(230)
50% Modulus, MPa	1.6	1.0	2.1	1.9	1.9	1.9
(psi)	(225)	(140)	(305)	(280)	(270)	(275)
100% Modulus, MPa	1.4	---	---	2.1	2.0	2.1
(psi)	(200)	---	---	(300)	(295)	(305)
Elongation at Break, %	150	70	70	300	235	270

Conclusions

Trilene® liquid EPDM in high durometer extrusion offers the weatherseal compounder unique advantage for reducing weight and cost by reducing the need for metal or plastic inserts or carriers.

Compared to alternative petroleum-based processing aids, Trilene® liquid polymers similarly facilitate easy processing of highly black-loaded stocks without trading-off rigidity and flex modulus for retained grip or sealing force.



	MPT @ 100˚C 723.22 sec - 1					
	K-1447	EPT-4010	535/5010	10% T77	20% T77	30% T77
Viscosity Poise	10713.53	11774.16	12060.17	10594.36	10308.34	10046.17
% Swell Running	13.18	8.61	14.53	14.36	14.19	14.19
% Swell Relaxed	11.82	10.47	14.02	15.37	17.40	12.50

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