TSE Industries, Inc.
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Properties of Millathane® 76/Natural Rubber Blends

Purpose

To evaluate the effect of blending Millathane 76*, a millable polyester polyurethane rubber, with natural rubber (SMR 5CV).

Results

1. The addition of Millathane 76 to natural rubber results in blends having higher modulus, hardness, and in some cases increased tear strength.

2. Millathane 76 greatly improves abrasion resistance as indicated by the Taber abrasion study. On this test, the 100% natural rubber compound degraded and became gummy. The addition of as little as 30 phr of Millathane 76 greatly improved abrasion resistance in both the amount of wear and in the type of wear.

3. The resistance to swelling of natural rubber in oil and fuel can be improved by the addition of 30 - 50 phr of Millathane 76.

4. The blends were minimally affected by heat aging 70 hours at 70ºC.

Conclusions

Millathane 76 can be used to upgrade natural rubber compounds for increased abrasion resistance, fuel and oil resistance, and increased modulus. Potential applications are in solid industrial tires, oil resistant mounts, vibration damping, shoe soles, hose covers, conveyor belting and other applications where abrasion properties are needed.

Compounds Tested

The following two formulas were mixed and then blended together to make the blend compounds shown in the data table.

Millathane® 76*	100.0	SMR 5CV	100.0
Zinc Stearate	0.5	Stearic Acid	1.0
N-326 Black	20.0	N-326 Black	20.0
MBTS	4.0	Zinc Oxide	5.0
MBT	2.0	MBTS	0.5
Thanecure® ZM	1.0	TMTD	0.5
Spider Sulfur	1.5	Spider Sulfur	2.5

* **Note:** Although Millathane 76 (Virgin) was used in this experiment, it is highly recommended that Millathane 76 Premilled be used, as it contains 1.5 phr of a polycarbodiimide hydrolysis stabilizer. The hydrolysis stabilizer (Millstab® P) greatly improves the resistance of the polymer, mixed compound and cured articles to moisture and water.

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Millathane® 76/Natural Rubber Blends

Millathane 76	100	70	50	30	
Natural Rubber (SMR 5CV)		30	50	70	100

Original Physical Properties

Press Cure, Minutes at 160ºC	10	7.5	5	5	5
Hardness Shore A	65	63	62	58	48
100% Modulus, MPa	3	2.2	1.8	1.6	1.2
psi	436	312	267	229	170
200% Modulus, MPa	7.3	3.8	3.3	2.9	2.4
psi	1058	551	477	428	341
300% Modulus, MPa	14.2	6.2	5.4	5.2	4.6
psi	2055	892	779	753	662
Tensile Strength, MPa	38.6	26.1	20.2	21.4	28.5
psi	5604	3785	2929	3110	4139
Elongation,%	510	721	626	592	670
Tear Die C, kN/m	64.3	51.5	47.9	36.9	43.1
lb/in	367	294	274	211	246

Abrasion Resistance, Taber Abrasion H18 Wheel

% Loss after 3000 Cycles	0.2	2.3	2.1	1.2	NT*
Appearance	Very Smooth	Severe Tearing	Slight Tearing	Smooth	Gummy

* Could not test, sample degraded

Compression Set, 22 hr/70º C

% set	48	68	67	30	17

Oven Aged 70 Hr/70ºC

Hardness Change, Points	5	2	0	3	2
Tensile Change, %	-25	0	10	4	3
Elongation Change, %	1	-25	-15	-13	-17

Fuel Resistance 70 Hr/23ºC ASTM Fuel A (Isooctane)

Hardness Change, Points	3	0	-4	-3	-2
Tensile Change, %	-3	-36	-38	-11	-7
Elongation Change, %	14	-24	-23	-11	-9
Volume Change, %	0	10	32	57	96

Oil Resistance 70 Hr/70ºC ASTM #3 Oil

Hardness Change, Points	5	-5	-9	-22	-20
Tensile Change, %	2	-44	-66	-85	-90
Elongation Change, %	8	-35	-43	-66	-67
Volume Change, %	1	13	33	101	193