RETARDER ESEN®

Surface-Treated Phthalic Anhydride

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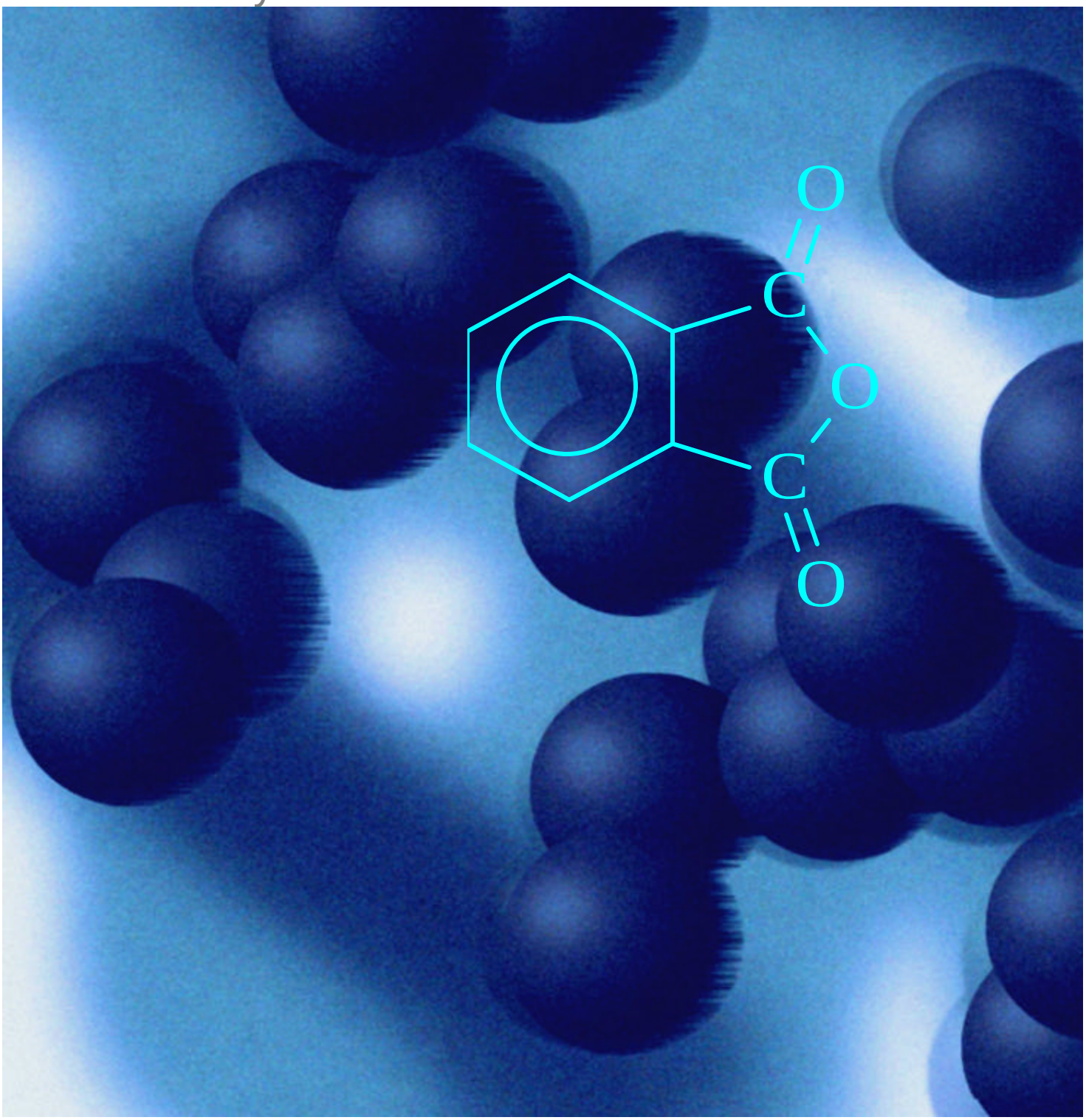

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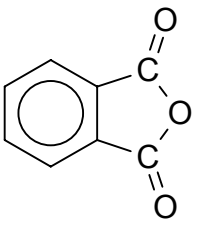
RETARDER ESEN®

RETARDER OR ANTISCORCH

Chemical Name and Formula

Surface-treated
Phthalic Anhydride



Physical Properties

Form:	White crystalline powder.
Specific Gravity:	1.53.
Melting Range:	127° to 132°C.
Flash Point:	132°C (270°F)
Storage Stability:	Generally good, but excessive moisture and open storage can cause change to phthalic acid. Keep dry in closed container.
Solubility:	Soluble in benzene, alcohol and ethylene dichloride. Moderately soluble in acetone. Insoluble in water and gasoline.
Handling Precautions:	Excessive dustiness is to be avoided as a source of possible irritation to mucous membranes.

Compounding Properties

Effect on Rate of Cure:	Greatly improves processing safety with a minimum effect on time to reach optimum cure.
Discoloration:	Relatively nondiscoloring. Will cause a creaming of a white stock during light exposure. Relatively nonstaining.
Processing:	Disperses readily.
Bloom:	Nonblooming.

FDA STATUS OF RETARDER ESEN

Retarder ESEN is approved under FDA regulations 21 CFR§ 175.105 (adhesives) and 177.2600 (Rubber Articles Intended for Repeated Use, 10% Limitation).

PROCESSING SAFETY WITH RETARDER ESEN

The important facts about Retarder ESEN are as follows:

1. Retarder ESEN is a general antiscorch for use in all stocks with all accelerators. Most effective with basic accelerators or combinations containing a basic activator.
2. Retarder ESEN functions in natural rubber, SBR, butyl, polyisoprene, polybutadiene, and nitrile-type rubber such as PARACRIL® NBR.
3. Retarder ESEN is a powerful retarder of vulcanization at processing temperatures with a minimum retarding action at curing temperatures.
4. From 0.25 to 1.0 parts of Retarder ESEN on the rubber hydrocarbon is recommended depending upon the result desired.

   Note: The effectiveness of Retarder ESEN decreases with increasing proportions of alkali process reclaim.
5. The processing safety acquired by adding ESEN to a compound cannot be obtained satisfactorily by a reduction in the accelerator content of a compound.

RETARDER ESEN IN A NON-BLACK NATURAL RUBBER COMPOUND

Retarder ESEN is effective as an antiscorch with all organic accelerators commonly used today. It is nondiscoloring and has no effect on aging. It is particularly effective in non-black natural rubber compounds accelerated with thiazole-guanidine, or thiazole-thiuram such as the stock shown below.

In such stocks it is very strong - 0.1 part in 100 parts of rubber increases the processing safety 50%, as measured by Mooney scorch at 121°C (250°F) - while causing only a very slight retardation of cure at 142°C (287°F). Increasing the amount to 0.2 parts gives additional safety with very little sacrifice in cure rate.

Stock D is shown as positive refutation of the old theory that by adjusting acceleration the need for an antiscorch can be eliminated.

To test this theory, the acceleration of stock A (Naugex® MBT 1.0 - MONEX® 0.1) was reduced in 10% decrements until Mooney scorch at 121°C (250°F) was equal to the control plus 0.1 part of Retarder ESEN (Stock B). To accomplish this it was necessary to reduce the acceleration to Naugex MBT 0.3 - MONEX 0.03. A reduction of this magnitude results in severe “accelerator starvation”. Stock D is extremely slow curing compared with the control and most important, even after a ten-minute cure its moduli are far below those obtained by Stock B after a five-minute cure. It is completely unsatisfactory for the use for which the compound was designed.

This compound, although accelerated for an air cure, was press cured at 142°C (287°F) so that a careful study of cure rates could be made.

BASE RECIPE

Smoked Sheets	100.0
Fast Cure Zinc Oxide	5.0
Whiting (water ground)	100.0
AMINOX®	0.5
Sulfur	2.5
LAUREX®	2.0
Total	210.0

	A	B	C	D
Base Recipe	210.0	210.0	210.0	210.0
Naugex MBT	1.0	1.0	1.0	0.3
MONEX	0.1	0.1	0.1	0.03
Retarder ESEN	-	0.1	0.2	-
Mooney at 121°C (250°F)				
Scorch Time, t_5	12	18	20	18

Unaged Physical Properties

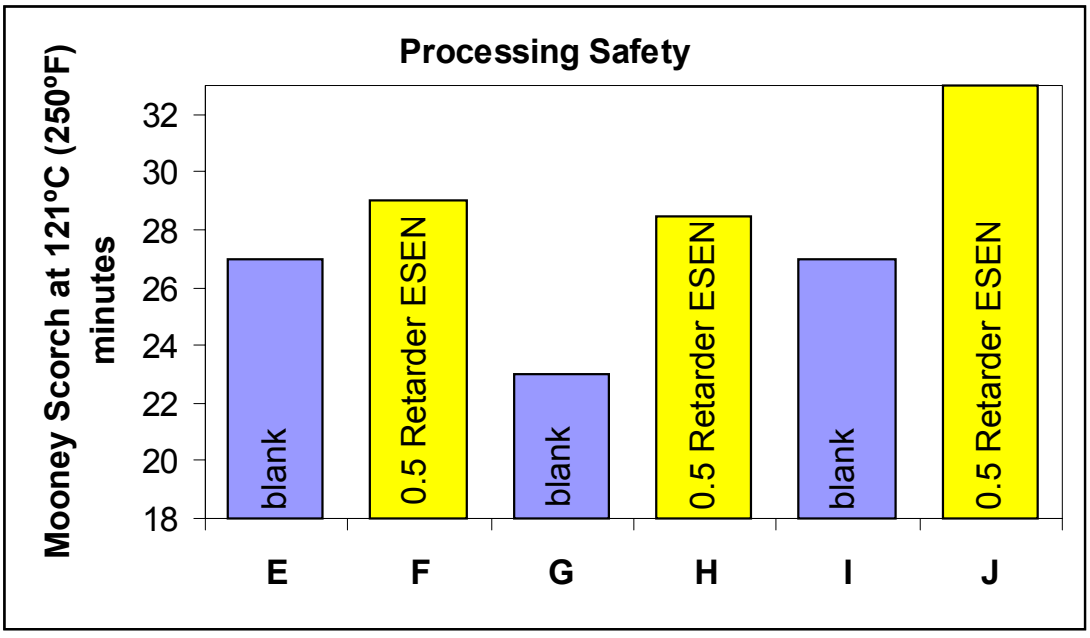
	A	B	C	D
Press Cure 5' @ 142°C (287°F)				
400% Modulus MPa	4.3	4.7	5.1	2.6
(psi)	(630)	(680)	(740)	(370)
Tensile Strength MPa	16.1	15.0	17.4	9.0
(psi)	(2330)	(2180)	(2530)	(1310)
Elongation at Break	660	645	665	700
Press Cure 10' @ 142°C (287°F)				
400% Modulus MPa	4.1	4.2	4.5	3.9
(psi)	(590)	(610)	(650)	(500)
Tensile Strength MPa	13.4	13.1	13.6	14.9
(psi)	(1940)	(1910)	(1970)	(2160)
Elongation at Break	625	625	620	705

RETARDER ESEN IN A CARBON BLACK LOADED NATURAL RUBBER COMPOUND

Retarder ESEN functions as an antiscorch agent in natural rubber compounds loaded with carbon black, although, in general, larger amounts are required than in nonblack stocks. The addition of 0.5 part of ESEN to a black stock shown here with three basic types of acceleration gives the increase in Scorch Time that is frequently more than enough to spell the difference between successful processing and a scorch problem.

BASE RECIPE

Smoked Sheets	100.0
BLE® 25	1.0
Zinc Oxide	5.0
S-301 (MPC) black	45.0
Pine Tar	3.5
LAUREX®	3.5
Sulfur	3.0
Total	161.0



	E	F	G	H	I	J
Base Recipe	161.0	161.0	161.0	161.0	161.0	161.0
Naugex® MBT	1.0	1.0	0.50	0.50	-	-
DPG	-	-	0.25	0.25	-	-
MONEX®	-	-	-	-	0.2	0.2
Retarder ESEN	-	0.5	-	0.5	-	0.5
Unaged Physical Properties						
Press Cured 30' @ 134°C (274°F)						
300 Modulus MPa	5.5	5.2	6.9	6.0	6.6	5.4
(psi)	(800)	(750)	(1000)	(870)	(950)	(790)
Tensile Strength MPa	24.3	24.1	28.6	25.4	27.1	26.3
(psi)	(3530)	(3490)	(4150)	(3690)	(3930)	(3820)
Elongation - %	670	690	690	670	680	690
Shore A Hardness	53	55	60	59	57	58

RETARDER ESEN IN AIR- CURED FOOTWEAR STOCKS

In the manufacture of footwear, the use of Retarder ESEN with the accelerations permits cures at the relatively low vulcanizing temperatures and prevents scorching at processing and storage temperatures. Retarder ESEN allows for the use of reworked cutting scrap in fresh stock without fear of scorching. The following air-ammonia cured natural rubber compound illustrates the effectiveness of Retarder ESEN as a retarder.

BASE RECIPE

Smoked Sheets	100.0
Whiting	40.0
Hard Clay	10.0
Zinc Oxide	5.0
Titanium Dioxide	30.0
LAUREX®	0.5
Sunproof® Extra	0.5
NAUGAWHITE®	1.2
Naugex MBTS	0.4
MONEX	0.02
Sulfur	1.65
Total	189.27

	K	L
Base Recipe	189.27	189.27
Retarder ESEN	-	0.2
Mooney Scorch at 121°C (250°F)		
Scorch Time, t_5 minutes	37.5	51.5
Unaged Physical Properties		
***Cure 40' @ 126.7°C (260°F)**		
200% Modulus MPa	2.8	3.2
(psi)	(410)	(460)
Tensile Strength MPa	21.2	20.5
(psi)	(3080)	(2970)
Elongation - %	656	630

* - Cure at 25 psi air plus 35 kPa (5 psi) ammonia after 30 minutes rise to 127°C (260°F)

RETARDER ESEN IN BLACK MOLDED SBR

Retarder ESEN has a wide range of effectiveness in SBR synthetic rubber. Shown here is an oil extended SBR 1712 compound loaded with N-330 (HAF) black. The effectiveness of a small amount of Retarder ESEN to improve processing safety is easily seen.

BASE RECIPE

SBR 1712	100.0
BLE 25	2.0
Zinc Oxide	5.0
N-330 (HAF) Black	50.0
Stearic Acid	1.0
Coal Tar Softener	10.0
Sulfur	1.75
Naugex MBTS	0.8
DPG	0.6
Total	171.15

	M	N
Base Recipe	171.15	171.15
Retarder ESEN	-	0.2
Mooney at 121°C (250°F)		
Scorch Time, t_5 minutes	24.2	28.8
Mooney at 132°C (270°F)		
Scorch Time, t_5 minutes	13.0	15.0
Unaged Physical Properties		
Cured 30' @ 145°C (293°F)		
300% Modulus MPa	9.2	8.1
(psi)	(1340)	(1180)
Tensile Strength MPa	17.9	18.3
(psi)	(2600)	(2660)
Elongation - %	530	550
Shore A Hardness	54	54

RETARDER ESEN IN SBR TILING

Retarder ESEN can be used to advantage in highly loaded, hot processing compounds such as tiling, mechanicals, soles and heels. The following white SBR floor tiling gave considerable scorching trouble until the ESEN was added to solve the problem.

SBR FLOOR TILE (WHITE)

	O
SBR 1503	100.0
High Styrene Resin	8.0
Para Coumarone Indene Resin (Light)	10.0
Zinc Oxide	3.0
Titanium Dioxide	15.0
Soft Clay	200.0
New York Talc	170.0
Heavy Calc. Magnesia	15.0
Ultramarine Blue	0.20
LAUREX®	5.0
Light Process Oil	13.0
Sunproof® Extra	2.0
Naugex MBTS	4.25
DPG	1.25
Retarder ESEN	0.75
Sulfur	7.0
Total	554.45

Cure 10' @ 162°C (324°F)	
Tensile MPa	7.7
(psi)	(1120)
Elongation - %	150
Hardness	92
Mooney Viscosity Compounded	95
Mooney Scorch @ 121°C (250°F)	
Scorch Time; t_5 - minutes	19

RETARDER ESEN IN BUTYL RUBBER

In Butyl, Retarder ESEN is effective in both black and nonblack stocks, and with both conventional sulfur and GMF or DIBENZO GMF® - red lead or Naugex MBTS activated cures. Up to 1.0 part of Retarder ESEN can be used effectively in fast-curing Butyl compounds

The following Bag-O-Matic diaphragm stock illustrates the effectiveness of Retarder ESEN as a retarder for GMF®-Naugex MBTS cure.

BUTYL TIRE CURING BAG STOCK

EXXON Butyl 268	1000
Zinc Oxide	5.0
N-601 (HMF) Black	40.0
N-770 (SRF) Black	20.0
Process Oil	8.0
Sulfur	2.0
Naugex MBTS	4.0
GMF	2.0
Total	181.0

	P	Q
Base Recipe	181.0	181.0
Retarder ESEN	-	1.0
Mooney Scorch at 121°C (250°F)		
Scorch Time, t_5 minutes	5.5	19.0
Unaged Physical Properties		
Cured 60' @ 153°C (307°F)		
200% Modulus MPa	6.3	5.9
(psi)	(910)	(850)
Tensile Strength MPa	11.9	11.0
(psi)	(1730)	(1600)
Elongation - %	350	400

RETARDERS IN PARACRIL® NITRILE-BUTADIENE RUBBERS

In a typical oil-resistant mechanical goods compound, four accelerator variations were used. Retarder ESEN and salicylic acid were compared on an equal weight basis.

The results of these comparisons show that:

1. With Naugex MBTS, Naugex MBT-DPG and MONEX acceleration, Retarder ESEN is superior to salicylic acid in retarding scorch at processing temperatures.

2. With DELAC® S, Retarder ESEN is much more powerful in retarding action.

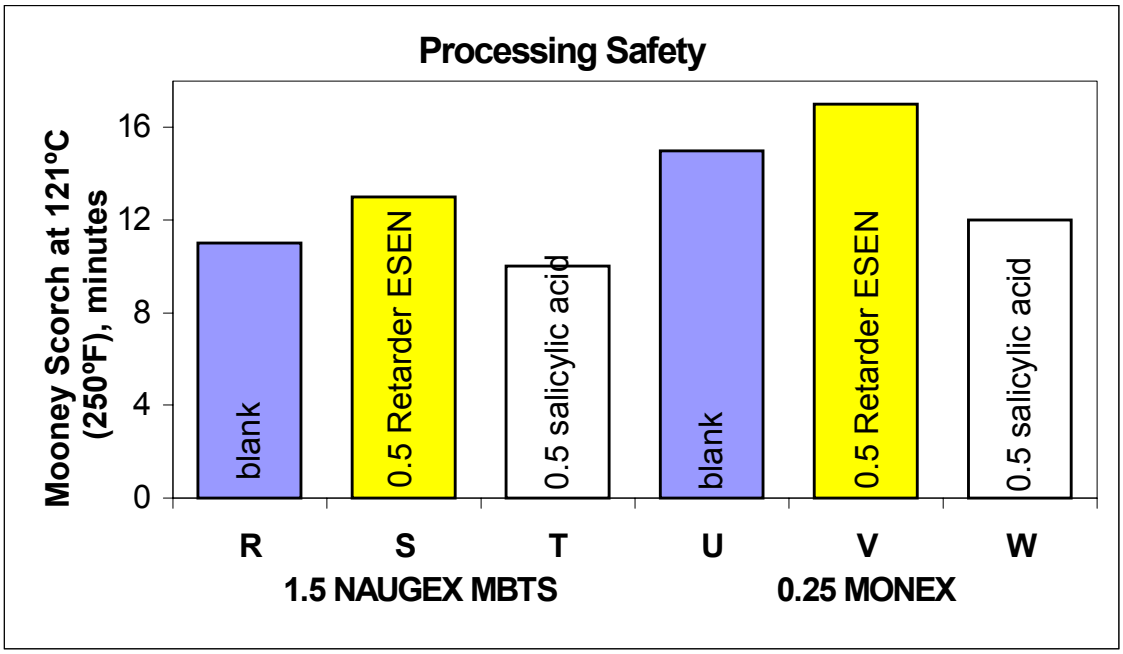
3. None of these chemicals retards the cure at 153°C (307°F).

Of supplementary interest, is the fact that MONEX offers safe, efficient, inexpensive acceleration for this type of compound.

BASE COMPOUND

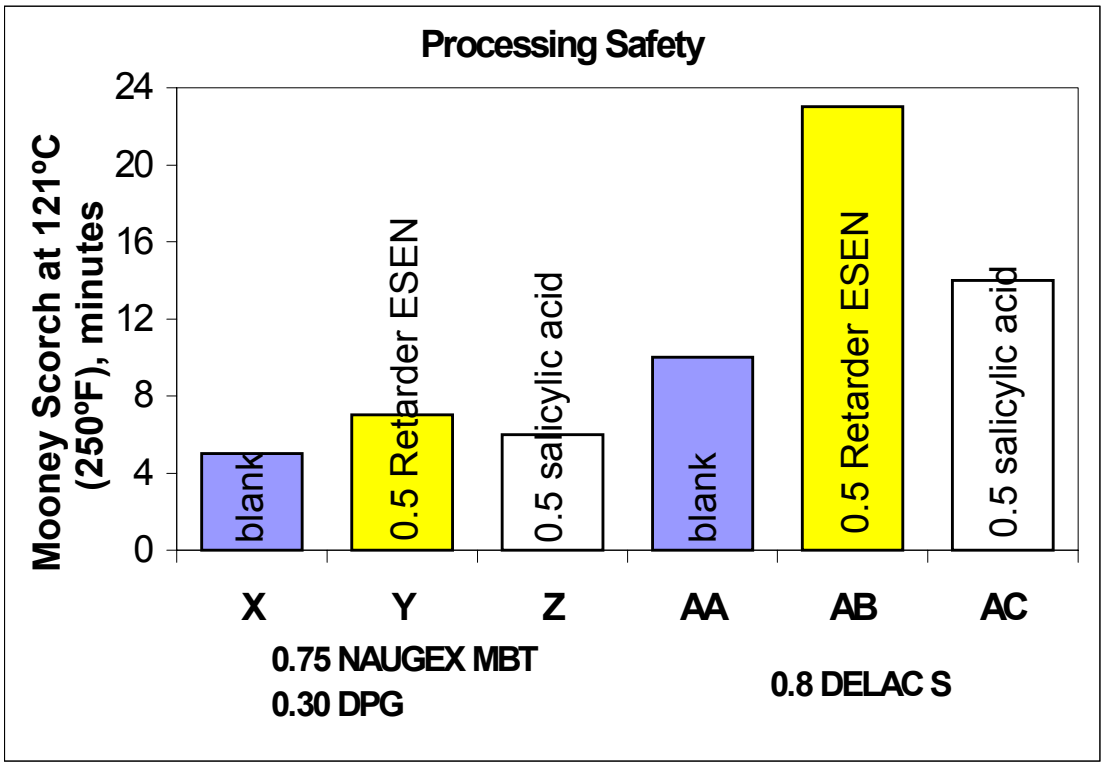
PARACRIL® BJ	100.00
Zinc Oxide	5.0
Stearic Acid	1.5
N-770 (SRF) Black	80.0
Cumarone-Indene Resins	20.0
AMINOX®	2.0
Sulfur	2.5
Total	211.0

	R	S	T	U	V	W
Base Recipe	211.0	211.0	211.0	211.0	211.0	211.0
Naugex® MBTS	1.5	1.5	1.5	-	-	-
MONEX	-	-	-	0.25	0.25	0.25
Retarder ESEN	-	0.5	-	-	0.5	-
Salicylic Acid	-	-	0.5	-	-	0.5



Unaged Physical Properties							
		R	S	T	U	V	W
Press Cured 20' @ 153°C (307°F)							
300 Modulus	MPa	14.3	14.5	15.4	21.7	19.3	20.7
	(psi)	(2070)	(2110)	(2230)	(3150)	(2800)	(3000)
Tensile Strength	MPa	18.7	18.1	19.0	22.6	22.1	22.1
	(psi)	(2710)	(2620)	(2750)	(3280)	(3200)	(3200)
Elongation - %		480	455	440	350	405	345
Hardness - Shore A		67	69	67	74	74	74

	X	Y	Z	AA	AB	AC
Base Recipe	211.0	211.0	211.0	211.0	211.0	211.0
Naugex® MBT	0.75	0.75	0.75	-	-	-
DPG	0.03	0.03	0.03	-	-	-
DELAC® S	-	-	-	0.8	0.8	0.8
Retarder ESEN	-	0.5	-	-	0.5	-
Salicylic Acid	-	-	0.5	-	-	0.5



Unaged Physical Properties							
		X	Y	Z	AA	AB	AC
Press Cured 20' @ 153°C (307°F)							
300 Modulus	MPa	16.5	16.2	16.8	17.6	16.5	17.9
	(psi)	(2390)	(2350)	(2430)	(2550)	(2390)	(2600)
Tensile Strength	MPa	20.8	20.8	21.4	22.0	21.7	22.3
	(psi)	(3020)	(3020)	(3100)	(3190)	(3150)	(3240)
Elongation - %		455	455	485	455	500	430
Hardness - Shore A		72	73	72	72	70	72