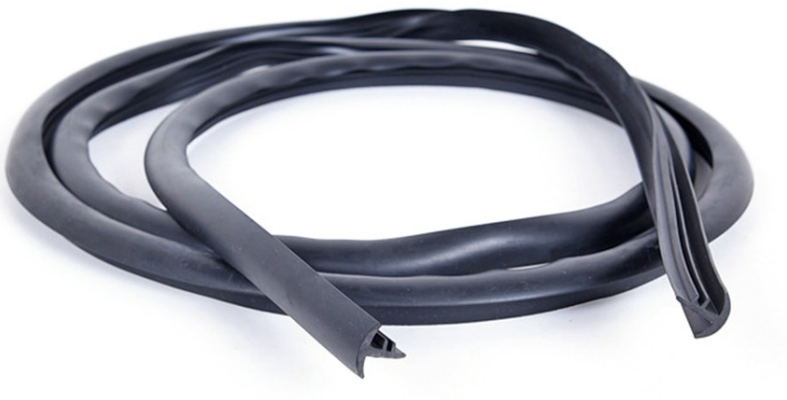
CarbonNeat

ENGINEERED BIO-FILLER



Neat90 in EPDM Window and Door Seal Application

Technical Bulletin:

Neat90 in EPDM Window and Door Seal Application

Objective

To formulate an EPDM recipe using Neat90 to replace all or a portion of N-550 and yield comparable qualities to that of a recipe using only N-550 while simultaneously improving the sustainability and economics of the compound.

Background

Injection and/or extruded rubber articles require compounds with certain special processing characteristics. Most notable of the processing characteristics is the requirement for a combination of low viscosity and sufficient scorch times to allow the rubber to be injected into the mold or extruded in a relatively short time to minimize cycle time, and still maintaining the benefits of smoother surfaces, better dimensional stability, and improved green strength.

This study was conducted and focused on the advantage of utilizing the Neat90 in combination with the semi-reinforcing ASTM grade N-550 carbon black (N550 has low surface area and high structure). Neat90 used was 20% oil treated to eliminate dust and to insure good dispersion, and consistency. The compound containing Neat90 results in improved green strength, good dimensional stability. And reduce the cost per pound volume while still maintaining good to excellent physical properties.

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Formulas and Testing:

- Formula #NB70XEPCN101S-CN90 was prepared for this study using:
  - One cure system; Sulfur
  - Two different filler levels; The Control w/Carbon Black and #NB70XEPCN101S-CN90 w/Neat90
  - Batches were mixed on a two-roll mill (6 lbs batch wt. capacity) using a step-by-step mixing procedure.
  - Compound formulations were developed specifically for window and door seal with a Durometer target of 70 +/-5

The following testing was performed using ASTM procedures:

- MDR (Rheometer) -

ML, in/lb. (low torque)
MH, in/lb. (high torque)
TS2 (minutes) (Delay of cure at 2 min.
T90 (minutes) (cure at 90%)

- Original physical properties; ASTM D-412 tested at room temperature (70˚F ~ 75ºF)
- Die C tear; ASTM D-624 tested at room temperature (70˚F ~ 75ºF)
- Compression set; ASTM D-395 Method B tested at 22hrs and 70hrs at 100˚C (212˚F)
- Heat Aging; ASTM D-573, tested at 70hrs and 168hrs at 100˚C (212˚F)
- Volume resistivity

Note –

- Slabs were molded for 20 min. at 340˚F. pre-conditioned for 8hrs ~ 16hrs at room temperature prior to testing.
- ½" buttons for compression set test were molded for 23 minutes at 340˚F

Testing was performed at:

Carbon Research and Development
5934 Windswept Blvd.
Wise, VA 24293

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- *Commercial Electronics*
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- *Fluid Power*
- *Industrial Controls*
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- *Medical*
- *Agriculture & Construction*

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Table 1

MATERIAL P/N	Control EDPM N550 Sulfur Cure	#NB70XEPCN101S-CN90 EDPM N550 / Neat90 Sulfur Cure
Royalene 512	98.47	98.47
R153-70	9.30	9.30
N-550	80.00	55.00
Neat90	**0.00**	**30.00**
Zinc Oxide, AZO 66T	5.00	5.00
Flectol TMQ	3.00	3.00
Polyethylene 617A	1.00	1.00
Stearic Acid	1.00	1.00
SUNPAR 2280	38.00	30.00
Spider Sulfur	2.50	2.50
Perkacit MBT-Pdr,-D	1.80	1.80
Sulfades (DPTT)	0.80	0.80
CaO	0.50	0.50
TOTAL formula wt.	**241.37**	**238.37**

The formulation #NB70XEPCN101S-CN90 listed above in table 1 was developed considering the following Major Requirements Of Extrusion Grades:

- Economical
- Easy to mix and extrude
- Good visual appearance
- Good green strength
- Smooth processing and preforming
- Dimensional stability and consistency

Importance In Extruded Products

After the polymer, fillers are the most critical material in an extrusion recipe. The proper grade selection is very important. By incorporating Neat90 with the N550 carbon black at the proper level has many benefits, such as; improve batch-to-batch consistency, improve surface appearance, improve processing, improve hot tear resistance, lower costs due to scrap reduction, and can reduce defects in thin walled applications.

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Table 2

Rheometric Properties @ 160°C	Control EPDM N550 Sulfur (20 min Cure)	#NB70XEPCN101S-CN90 EPDM N550 / Neat90 Sulfur (20 min Cure)
ML, in/lb.	1	1.01
MH, in/lb.	10.02	12.49
TS2 (minutes)	0.7822	1.1
T90 (minutes)	7.91	8.2

The Rheometric properties *(table 2)*

Compound #NB70XEPCN101S-CN90 shows excellent viscosity (ML), material can easily inject / extrude. Processing safety (Ts2) providing enough time to fill the cavities without scorching. Based on both factors, #NB70XEPCN101S-CN90 should have excellent visual appearance and a very smooth surface.

Table 3

Vulcanization Properties *ASTM D-412*	Control EPDM N550 Sulfur (20 min Cure)	#NB70XEPCN101S-CN90 EPDM N550 / Neat90 Sulfur (20 min Cure)
Durometer (Shore A)	71	69
300% Modius	1176	1091
Tensile Strength	2183.28	2099
Elongation at Break (%)	697.74	667
Tear Strength (kN/m) Die C	54.65	45.15

Vulcanization Properties *(table 3)*

Compound #NB70XEPCN101S-CN90 exhibited good and acceptable data suitable for auto window and door seals. Sulfur cured Control and #NB70XEPCN101S-CN90 exhibit similar 300% Modulus, Tensile strength, and Elongation % with slight reduction in compound #NB70XEPCN101S-CN90 Elongation and Tear strength which most specifications accept and support.

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Table 4

Compression Set (%) ASTM D-395 Method B	Control EDPM N550 Sulfur (20 min Cure)	#NB70XEPCN101S-CN90 EDPM N550 / Neat90 Sulfur (20 min Cure)
22 hrs. @ 100°C (%)	17.04	17.17
70 hrs. @ 100°C (%)	20.22	20.00

Compression Set *(table 4)*

The 22hrs & 70 hrs. /100˚C Compression set in both; Sulfur cured Control and compound #NB70XEPCN101S-CN90 show equal values.

Table 5

Heat Aging Properties (%) ASTM D-573	Control EDPM N550 Sulfur (20 min Cure)	#NB70XEPCN101S-CN90 EDPM N550 / Neat90 Sulfur (20 min Cure)
70 hrs. @ 100°C (%)		
Durometer Change, Points	2	4.5
Tensile Strength Change %	10.71	-8.27
Elongation Change %	-18.13	-18.59
168 hrs. @ 100°C (%)		
Durometer Change, Points	1	0
Tensile Strength Change %	10.05	-5.61
Elongation Change %	-23.45	-24.05

Heat Aging Properties *(table 5)*

The 70hrs/100˚C heat aging, shows acceptable hardness change in both compounds with slight decrease in Tensile values with compound #NB70XEPCN101S-CN90 which is acceptable by most window and door seal specifications. Elongation change for Control and #NB70XEPCN101S-CN90 are similar.

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Table 6

Volume Resistivity	Control EDPM N550 Sulfur Cured	#NB70XEPCN101S-CN90 EDPM N550 / Neat90 Sulfur Cured
Thickness of disk (mm)	2.102	2.046
Specimen Diameter (mm)	98	98
Resistivity (Ωcm)	1.28983E+07	3.58927E+07

Volume Resistivity *(table 6)*

#NB70XEPCN101S-CN90 shows excellent volume resistivity over N-550.

Table 7

MATERIAL P/N	Control EDPM N550 Sulfur Cure	#NB70XEPCN101S-CN90 EDPM N550 / Neat90 Sulfur Cure
Specific Gravity	**1.08**	**1.07**
Cost/Lbs.	**1.570**	**1.527**
Cost/Lbs. volume cost	**1.696**	**1.634**

Conclusion

- Compound NB70XEPCN101S-CN90 consists of 12.5% Neat90 proving that a bio-based renewable filler can yield good to excellent results.
- Compound #NB70XEPCN101S-CN90 has acceptable physical properties and demonstrated improved cost per pound volume improvement. In addition, #NB70XEPCN101S-CN90 showed good dispersion.
- Compound #NB70XEPCN101S-CN90 shows superior compression set results, making it ideal for sealing applications.
- Neat90 offers a new balance of properties and excellent tolerance when blending with traditional carbon black materials, particularly with N-550.

- End of Report -

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Neat90

Elastomers - Plastics - Paints - Coatings - Concrete

Neat90; a renewable amorphous carbon material derived from sustainable biomass feedstock utilizing a proprietary, $C0_2$ neutral, auto-thermic technology.

Characteristic	*Target*	Units	ASTM
DBP Absorption	**74**	cm3/100g	D 2414 B
Iodine Adsorption	**> 145**	g/kg	D 1510
Moisture (as packaged)	**< 2.5**	%	D 7582
Ash (dry)	**< 3.0**	%	D 7582
Fixed Carbon (dry)	**> 91.0**	%	D 7582
pH	**9 - 10**	— —	D 1512
Bulk Density	**544**	kg/m3	— —
Pour Density	**338**	— —	D 1513
Specific Gravity	**1.2**	— —	D 792-13
PAHs	**Non-detect**	5 ppb	— —
Particle Size (D50)	**5.5**	µm	— —