Thermax® N990CG in Rubber Compounds

Thermax® N990CG is a low PAH grade of thermal carbon black which gives customers the ability to minimize the PAH content in their products, without sacrificing the quality and performance synonymous with Thermax.

The PAH content of N990CG is measured according to ASTM D8143 to ensure compliance with Commission Regulation (EU) No. 10/2011. Generally, other PAH regulations apply to final parts and therefore compliance with those regulatory requirements will necessitate testing on the vulcanized compounds. This includes regulations or quality certifications such as (EU) No. 1272/2013 and Geprüfte Sicherheit (GS) Marek.

Rubber compounding and testing were performed to compare Thermax® N990CG to a control N990 in various polymers. **The results indicate that N990CG is a drop-in replacement for N990**, allowing customers to reduce the PAH content of their products while maintaining the processing, physical, and dynamic properties of the rubber. We recommend customers perform their own compounding with Thermax® N990CG to confirm their compound retains similar properties.

Compounding and Testing Details

- The properties of the N990CG lot and the control lot can be found in Table 1.
- Polymers included in the testing were bromobutyl rubber (BIIR), chloroprene rubber (CR), ethylene propylene diene monomer rubber (EPDM), hydrogenated nitrile butadiene rubber (HNBR), nitrile butadiene rubber (NBR), and natural rubber (NR).
- The formulations used can be found at the end of this document.
- Mooney viscosity, MDR, Payne effect, tensile, hardness, and compression set tests were run on all compounds.
- Testing results can be found in the figures on the following pages.

Table 1. Properties of lots of N990CG and control N990

Property	Units	N990CG	N990
Ash	%	0.10	0.12
Fines	%	5.2	4.0
Heat Loss	%	0	0
Sieve Residue: 325 Mesh	ppm	1	1
Sieve Residue: 60 Mesh	ppm	0	0
Magnetics	ppm	0	0
Toluene Extraction	%	0.02	0.13
Nitrogen Surface Area (NSA)	m^2/g	9.1	9.0
Oil Absorption Number (OAN)	$cm^3/100g$	37.6	42.0
Individual Pellet Hardness Tester (IPHT), average	g	20	18
IPHT, average of 3 highest	g	32	28
pH		9.8	10.3

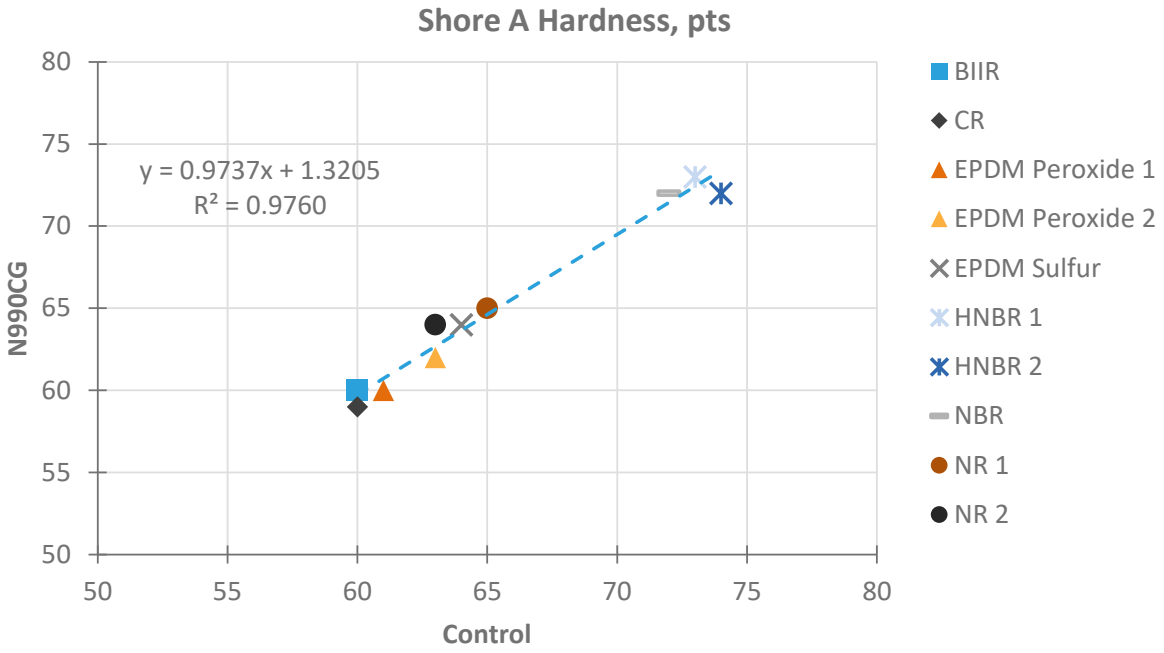

Figure 1. Shore A hardness of the compounds measured according to ASTM D2240. No significant differences were observed.

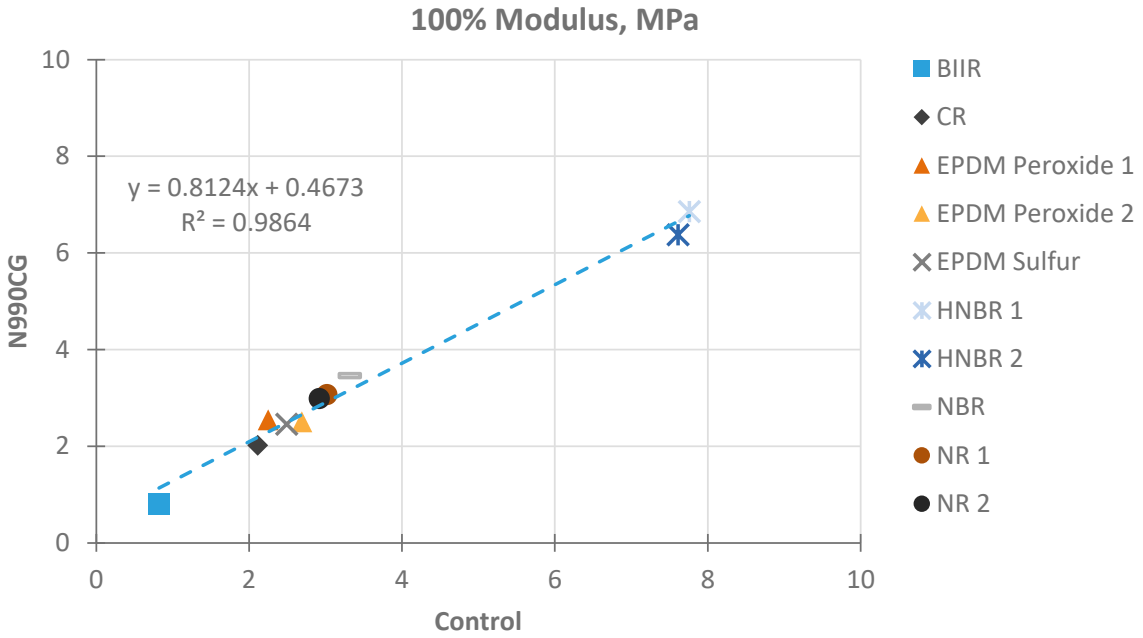

Figure 2. Stress at 100% strain of the compounds measured according to ASTM D412. Most compounds showed no significant difference. HNBR with N990CG had ~10% lower modulus in both mixes. This could be at least partly explained by the lower OAN of the N990CG lot. The HNBR compounds also had the lowest ultimate elongations (<200%) among the compounds tested which could contribute to variance at 100% strain.

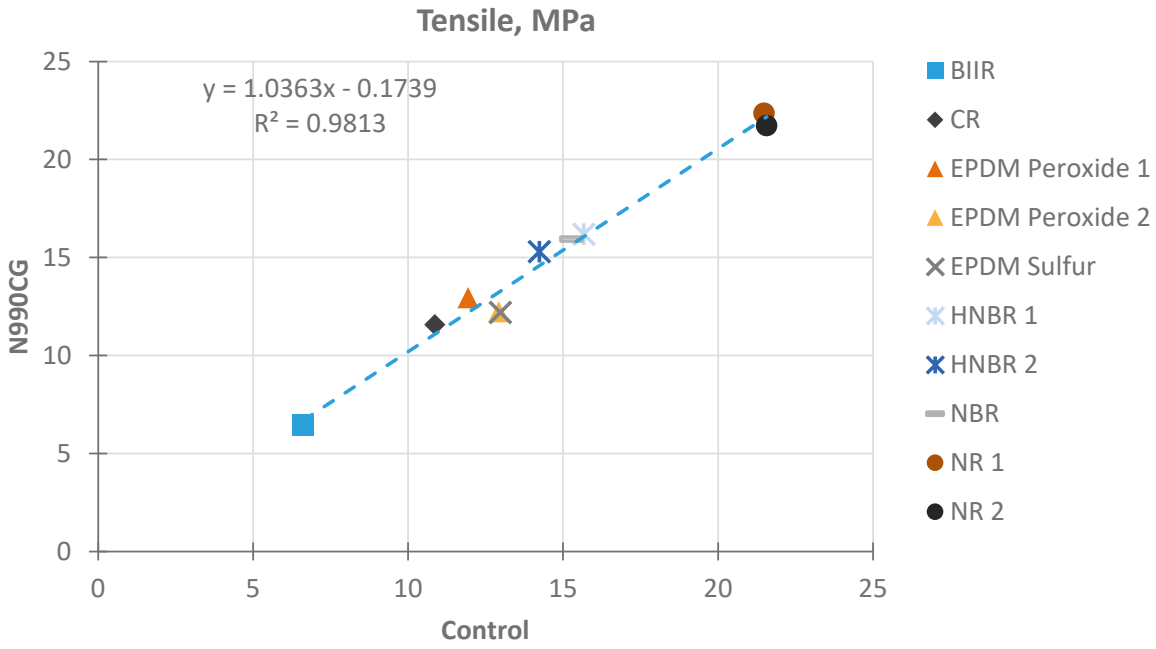

Figure 3. Tensile strength of the compounds measured according to ASTM D412. No significant differences were observed.

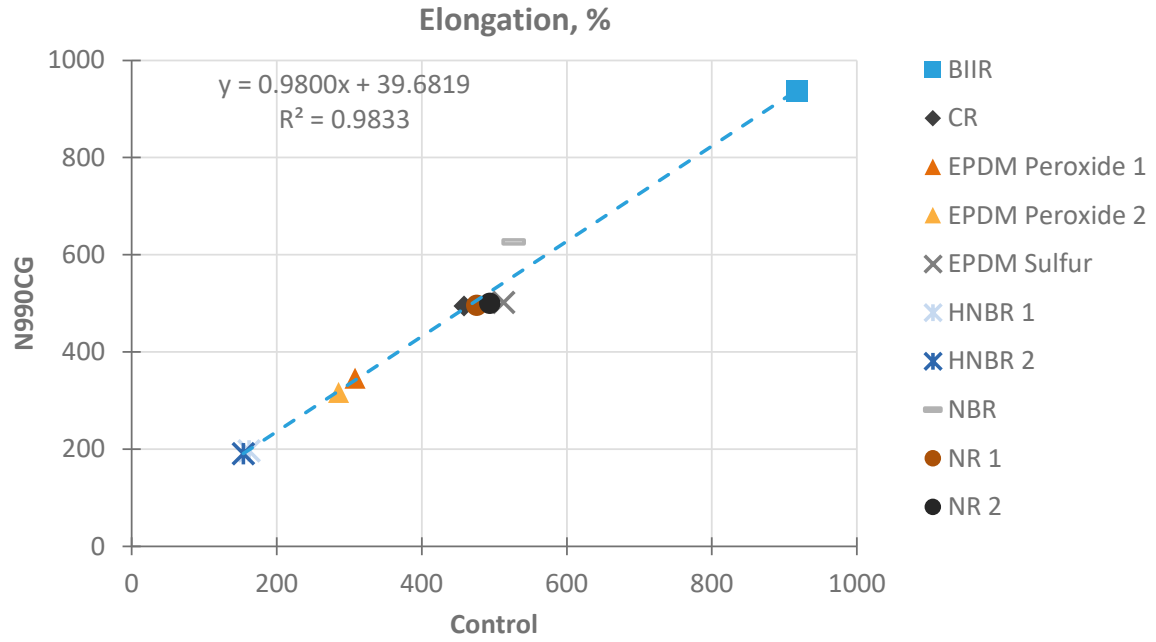

Figure 4. Elongation at break of the compounds measured according to ASTM D412. Elongations tended to be higher for the N990CG compounds which can be at least partly explained by the lower OAN of the N990CG lot.

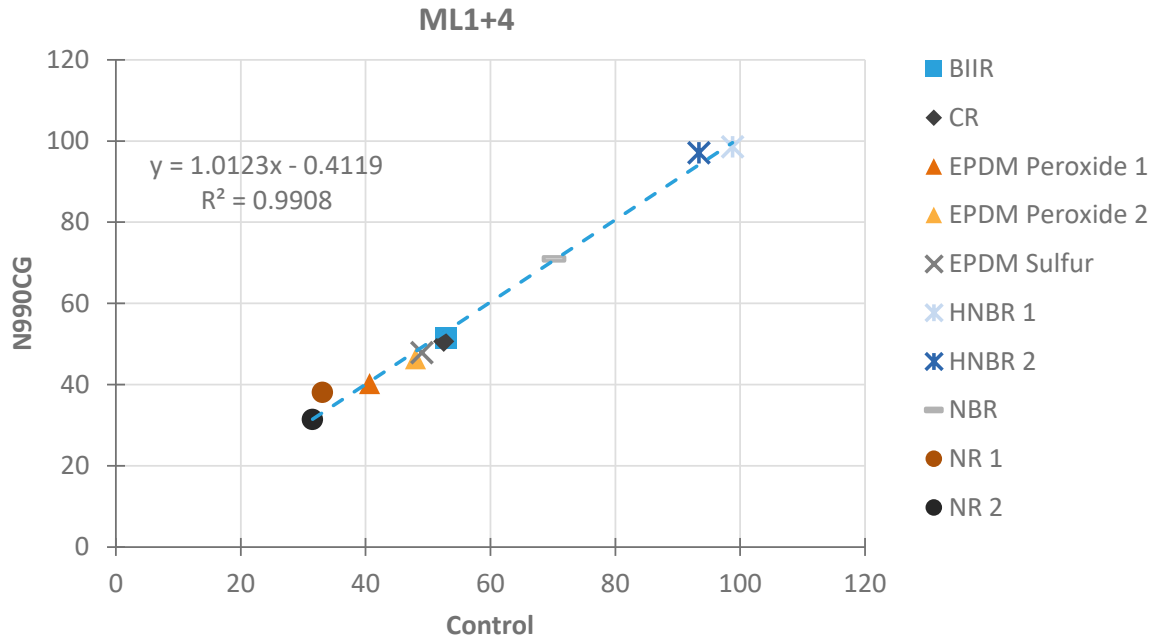

Figure 5. Mooney viscosity of the compounds measured at 100°C according to ASTM D1646. No significant differences were observed.

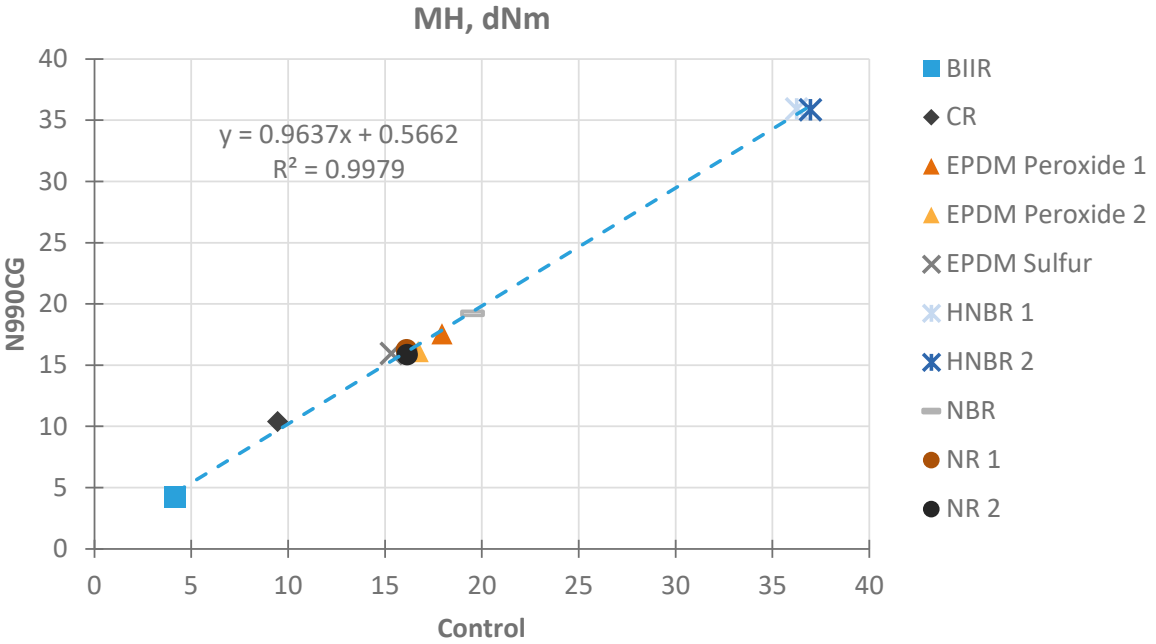

Figure 6. Maximum torque, MH, measured at 160°C according to ASTM D5289. No significant differences were observed.

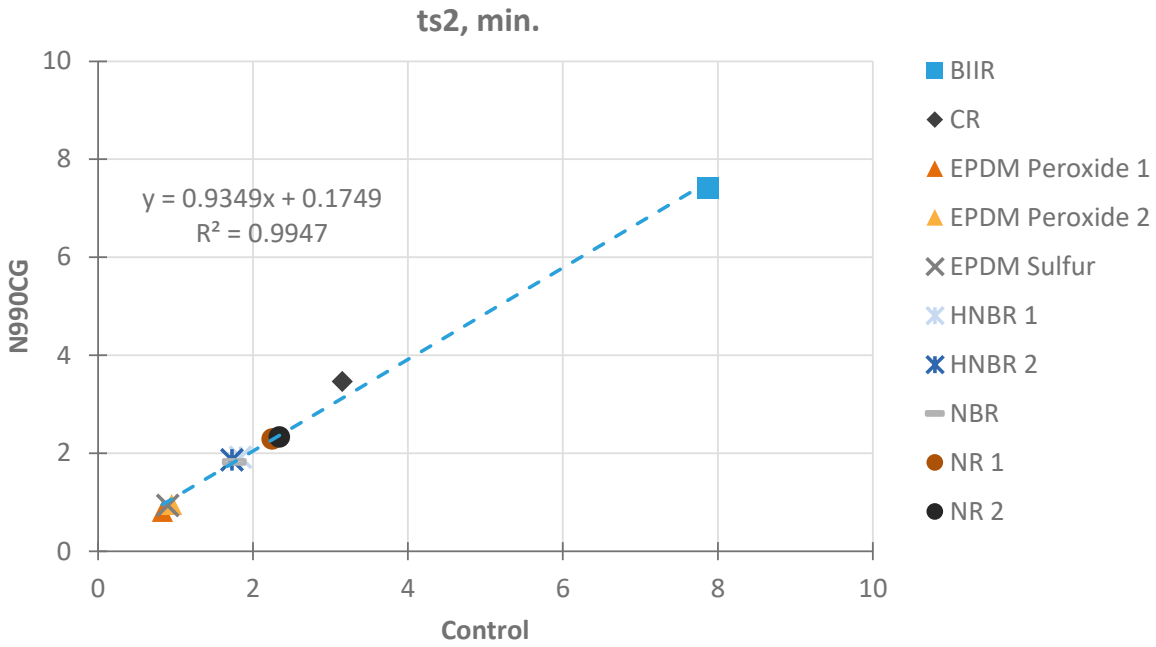

Figure 7. Scorch time, ts2, of the compounds measured according to ASTM D5289. No significant differences were observed.

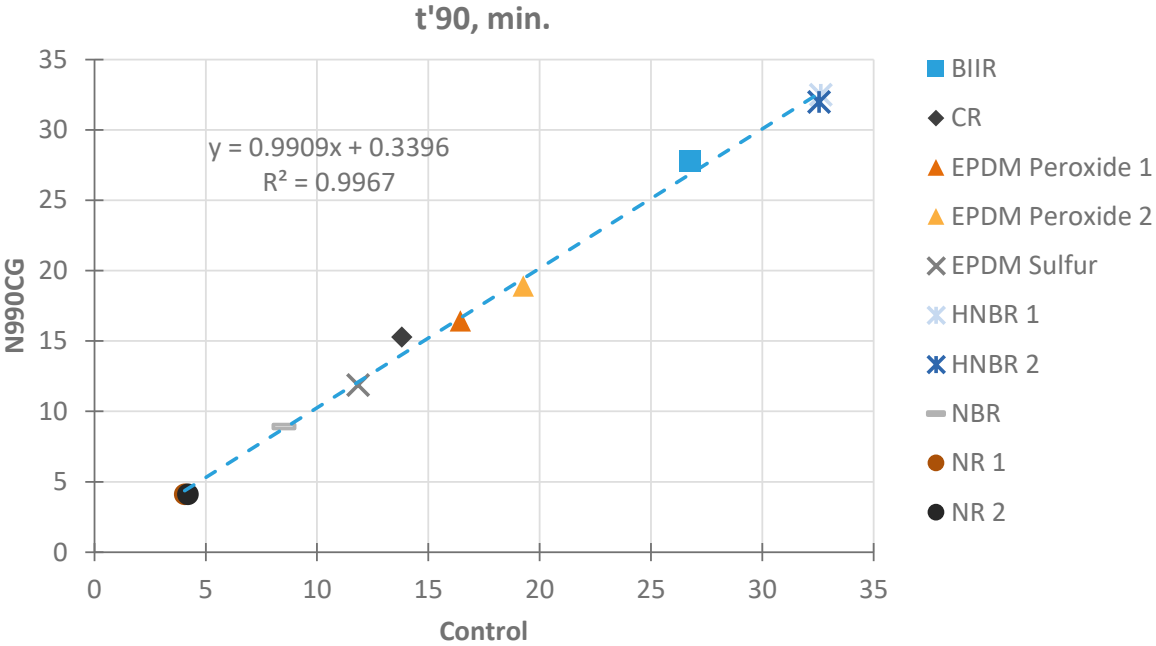

Figure 8. Cure time, t'90, of the compounds measured according to ASTM D5289. No significant differences were observed.

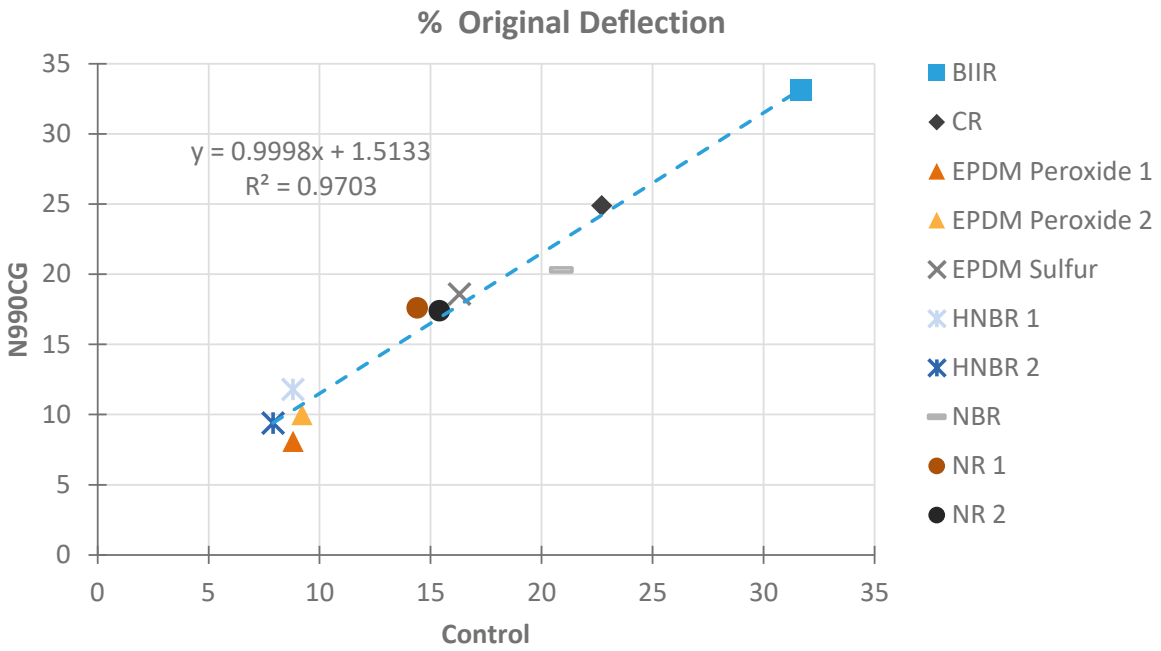

Figure 9. Compression set measured after 22 hours at 70°C according to ASTM D395 Method B. No significant differences were observed.

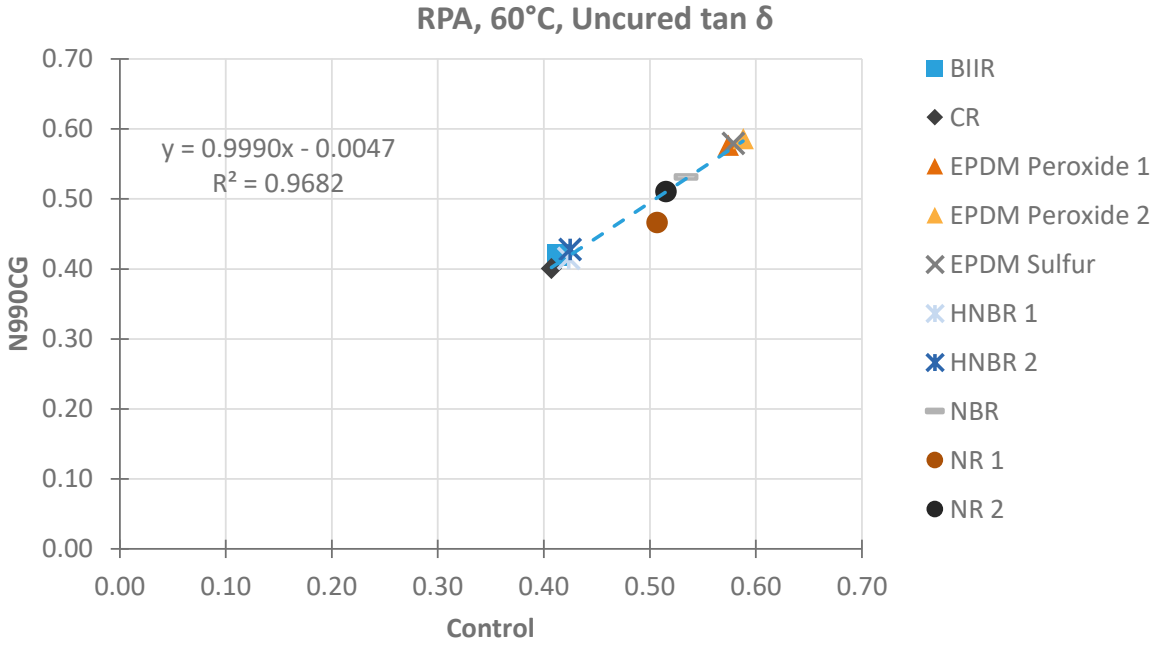

Figure 10. Uncured tan δ measured at 60°C, 1 Hz, and 1.0% strain. No significant differences were observed.

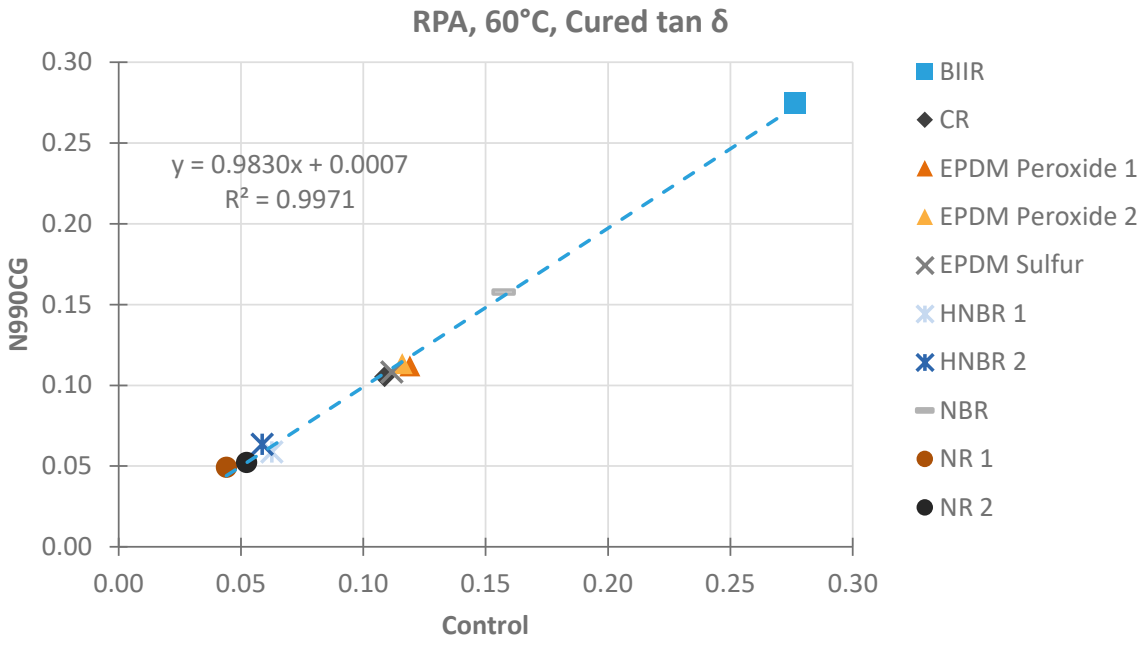

Figure 11. Cured tan δ measured at 60°C, 1 Hz, and 1.0% strain. No significant differences were observed.

Table 2. BIIR formulation

Ingredient	Loading, phr
Bromobutyl 2030	100.0
N660	30.0
N990	**60.0**
Naphthenic Oil	8.0
Struktol 40 MS	7.0
Escorez 1102 Resin	2.0
SP-1068	2.0
Stearic Acid	2.0
ZnO	3.0
MBTS	1.5
Sulfur	0.5
Total	**216.0**

Table 3. CR formulation

Ingredient	Loading, phr
Neoprene W	100.0
N990	**50.0**
Vanfre AP-2	2.0
Stearic Acid	0.5
MgO	4.0
ZnO	5.0
ODP	2.0
Plasticizer	5.0
TMTD	1.0
Total	**169.5**

Table 4. Peroxide cured EPDM formulation

Ingredient	Loading, phr
Royalene 512	100.0
N550	40.0
N990	**80.0**
Paraffinic Oil	50.0
DCP (40%)	8.0
TMQ	1.0
HVA-2	1.0
Total	**280.0**

Table 5. Sulfur cured EPDM formulation

Ingredient	Loading, phr
Royalene 512	100.0
N550	40.0
N990	**80.0**
Paraffinic Oil	50.0
TMTD	0.8
TDEDC	0.8
DPTH	0.8
MBT	1.5
Zinc Stearate	1.0
ZnO	5.0
Sulfur	0.5
Total	**280.4**

Table 6. HNBR formulation

Ingredient	Loading, phr
Zetpol 2010	100.0
N762	10.0
N990	**50.0**
Hydrotalcite FG	3.0
Vanox CDPA	1.5
Vanox ZMTI	1.0
TAIC	5.0
Vulkup 40KE	11.0
Total	**181.5**

Table 7. NBR formulation

Ingredient	Loading, phr
Nipol DN3350	100.0
N550	40.0
N990	**50.0**
ZnO	5.0
Stearic Acid	1.0
Agerite Resin D Pastilles	2.0
DOA	10.0
MBTS	1.5
Sulfur	1.5
Total	**211.0**

Table 8. NR formulation

Ingredient	Loading, phr
SMR CV60	100.0
N762	40.0
N990	**30.0**
Vanfre AP-2	2.0
TMQ	1.0
Akrowax 5026	1.0
Antiozonant PD-1	2.0
Stearic Acid	1.0
ZnO	5.0
Sulfur	1.0
DTDM	1.2
MBTS	0.6
TMTM	0.2
TBBS	0.65
PVI (CTP)	0.3
Total	**185.95**