

TECHNICAL Bulletin

Subject: HNBR Compounds

Bulletin #: 021

Date: January 2000

THERMAX® MEDIUM THERMAL BLACK N990 IN HNBR

Thermax® medium thermal carbon black N990 is manufactured by the thermal decomposition of natural gas. The thermal process provides a unique carbon black characterized by a large particle size and low structure. Thermax® is widely used in applications that require excellent aging and dynamic properties. The large particle size (low surface area) and low structure allow for low compression set, high rebound and low hysteresis, maintaining the inherent elastomeric properties of the rubber compound. As a non-reinforcing black, thermal black is often blended with furnace carbon blacks and/or mineral fillers to achieve cost reduction and specific physical properties in the rubber compound.

Thermax® can be used in all polymers and is commonly used in new high cost polymers such as HNBR, ACM and ECO. High loadings of Thermax® are possible, while maintaining low compression set and high resiliency, thereby allowing manufacturers to reduce compound cost. The combination of Thermax® N990 and HNBR provides excellent oil and chemical resistance and excellent high and low temperature properties. HNBR compounds filled with Thermax® are used for applications such as:

- Seals, gaskets, o-rings
- Tubing, hoses, pump parts, belts
- Oilfield and drilling applications, diaphragms
- Roll coverings

Following is a comparison of the effect of equal loadings of carbon black in an HNBR compound (Zetpol 2010, manufactured by Zeon Chemicals).

Formulation

HNBR (Zetpol 2010)	100.0
Carbon Black	75
Zinc Oxide	5.0
Stearic Acid	0.50
Plasthall TOTM Plasticizer	5.0
Naugard 445 Antioxidant	1.50
Vanox ZMTI Antioxidant	1.00
Vulcup 40KE Peroxide Vulc. Agent	8.00

Carbon Black Type	N330	N660	N774	N990	Austin Black
Loading, phr	75	75	75	75	75
Mooney Viscosity, ML 1 + 4 @ 100°C					
	144.9	117.9	107.4	86.6	117.4
Mooney Scorch, MS 1 + 30, 125°C					
Viscosity, minimum	106.2	77.0	69.4	52.6	74.2
t5, minutes	23.1	21.6	24.5	29.3	22.0
t35, minutes	>30	>30	>30	>30	>30
Rheometer, Microdie, 100 cpm, 3°arc @ 170°C					
ML, dN.m	22.9	18.8	18.2	15.9	21.5
MH, dN.m	94.8	96.5	91.3	91.3	88.2
ts2, minutes	1.1	1.3	1.3	1.8	1.7
t90, minutes	12.7	13.6	12.9	15.4	14.2
100% Modulus, MPa	11.3	10.3	9.5	4.6	5.6
300% Modulus, MPa	0	0	0	16.4	8.7
Tensile Strength, MPa	34.9	28.2	27.7	16.6	12.3
Elongation (%)	224	237	259	345	450
Hardness, Shore A, parts	82	79	78	69	77
Tie, Die C, 23°C, kN/cm	38.4	37.7	35.0	30.8	30.5
Comp. Set, B, %, 70 hours @ 150°C	26.9	16.5	16.6	15.6	25.7
Bayshore Resilience					
Rebound (%)	22	28	27	34	28
Aged Properties, Air Oven, 70 hours @ 150°C					
Hardness, parts change	8	6	6	5	4
Tensile, % change	-10	-1	-14	-3	-12
Elongation, % change	-19	-16	-35	-29	-35
Dynamic Properties, Dynamic Spectrometer Load 4.768 Kgf/cm², Temp. Sweep, 3°C/min					
Note: Carbon Black Loading @ 50 phr for all compounds					
E'' (MPa), -50°C	126.5	57.13	58.6	76.2	63.3
E' (MPa)	2539	2864	2773	2495	2032
Tan Delta	0.050	0.020	0.021	0.116	0.031
E'' (MPa), +175°C	1.032	0.8075	0.7146	0.4902	0.6565
E' (MPa)	9.847	8.480	8.141	6.312	8.828
Tan Delta	0.105	0.095	0.088	0.078	0.074

**Data Source: Zeon Chemicals, Carbon Black Study
with Peroxide Cured ZETPOL, January 1994**

The results on the previous page demonstrate the typical effects of N990 in elastomers. The viscosity is lowest for the N990 compound, and will allow for easy processing and good flow into intricate molds. This may be particularly beneficial for injection molding. The t90 cure time for the N990 compound is the longest, allowing for additional scorch safety.

Low modulus, low tensile strength and high elongation are evident with the low structure, large particle size N990. As a non-reinforcing carbon black, Thermax® N990 is often blended with other carbon blacks or mineral fillers to achieve specific properties, such as higher tensile strength. Tear strength is also low with the N990 compound, due to the lack of chain reinforcement of the polymer from the carbon black.

The N990 compound showed the lowest compression set, and therefore is commonly used in seals, gaskets and o-rings. The N990 compound also had the highest rebound resilience, hence its use in applications that require excellent dynamic properties. N990 also helps to maintain low hysteresis, even at elevated temperatures.

Following is a guide recipe:

HNBR	100.00
Active Zinc Oxide	2.00
Scorchguard O	2.00
SDPA-Antioxidant	1.00
Vulkanox ZMB 2	0.4
Thermax® N990	100.00
Disflamoll DPK	10.00
Bis-maleinimide	1.50
Dicumyl peroxide, 40%	7.50

Vulcanizate Properties

Shore A Hardness	72
Tensile strength, MPa	16.9
Elongation (%)	325
Modulus 100%, MPa	4.7

Source: Bayer: Technical Information, Hydrogenated Nitrile Rubber, Properties and Recent Trends in Application Development.

Thermax® N990 is used in loadings of up to 200 phr in high performance polymers such as HNBR.