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TECHNICAL BULLETIN

N990 Medium Thermal Carbon Black in HNBR Rubber Compounds

Thermax® medium thermal carbon black N990 (MT black) is a unique carbon black characterized by large particle size (low surface area) and low structure. Manufactured by the thermal decomposition of natural gas, Thermax® is widely used in applications that require excellent heat, oil and chemical resistance, as well as superior dynamic properties. The large particle size and low structure provide compounds with low compression set, high rebound and low hysteresis as the inherent elastic properties of the polymer are maintained. Thermax® can be used with all polymers and is commonly used in compounds of elastomers such as FKM, CR, NR, IIR, NBR, EPDM, HNBR, ACM and ECO.

The large particle size and low structure of thermal black provides less reinforcement and blending with furnace carbon blacks and/or mineral fillers is often employed to achieve cost reduction and specific physical properties in a rubber compound. HNBR possesses high gum tensile properties, which allow it to maintain excellent mechanical properties while using high loadings of MT Black.

The following study, conducted on behalf of Cancarb Limited by the Indian Rubber Manufacturers Research Association, Thane, India, shows the effect of replacing all or part of FEF black N550 with Thermax® N990 in the following HNBR compounds of three different shore A hardnesses (60, 70 and 80).

Compound Recipes

Formulation (phr)	Hardness 60 SH		Hardness 70 SH		Hardness 80 SH	
	A1	A2	B1	B2	C1	C2
HNBR*	100	100	100	100	100	100
Stearic acid	1	1	1	1	1	1
Zinc Oxide	5	5	5	5	5	5
FEF N550	20	--	35	--	65	25
Thermax® N990	--	40	--	75	--	75
Plasticizer TOTM	5	5	5	5	5	5
Akrochem VC 40K	10	10	10	10	10	10
Co-agent TAIC	3	3	3	3	3	3
Naugard 445	1.1	1.1	1.1	1.1	1.1	1.1
Vulkanox ZMB2	0.4	0.4	0.4	0.4	0.4	0.4

*Therban A3406 from Lanxess Deutschland GmbH – A fully hydrogenated butadiene acrylonitrile co-polymer with an ACN content of 34±1%, and a Mooney ML 1+4@100°C of 63±7.

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Test Compound Properties

Compound	A1	A2	B1	B2	C1	C2
Viscosity ML(1+4) @ 100°C	51	55	62	69	96	89
Mooney Scorch time t5 @ 125°C (min)	33	32	29	24	18	15
Rheometric Properties @160°C						
M_L (lbf.inch)	15.08	15.94	17.14	18.99	22.36	20.97
M_H (lbf.inch)	113.50	122.38	122.73	136.32	147.60	152.32
t_S2 (min)	1.49	1.38	1.33	1.27	1.19	1.16
t90 (min)	14.52	15.45	13.96	17.42	15.31	17.90
Vulcanizate Properties Curing at 160°C for t90 minutes according to Rheometer						
Hardness (Shore A)	59	59	67	68	79	78
100% modulus (Kg/cm^2)	22	23	31	33	67	59
200% modulus (Kg/cm^2)	65	71	120	121	267	227
300% modulus (Kg/cm^2)	159	163	225	199	--	--
Tensile Strength (Kg/cm^2)	238	234	239	207	293	251
Elongation @ Break (%)	380	400	320	350	210	210
Tear Strength (Kg/cm)	35	35	43	46	43	43
Compression Set % (@150°C/70hr/25% deflection)	25	23	17	16	22	18

Compound viscosity is maintained for the 60 and 70 shore A compounds and is improved for the 80 shore A compound which is extremely beneficial to processing. Thermax®, even at comparatively higher loadings to the N550, does not adversely affect Mooney scorch or curing behaviour.

Improvement in compression set resistance is noticeable for all of the compounds using Thermax® N990. This improvement is very beneficial for applications that require good sealing properties such as; seals, gaskets, “o” rings and hoses (for better clamp-fitting), which are the popular applications of HNBR.

Compound	A1	A2	B1	B2	C1	C2
Change in physical properties after ageing @ 150° C for 72 hours						
Hardness change (points)	+4	+4	+3	+3	+5	+4
100% modulus change (%)	+18	+13	+29	+15	+49	+30
200% modulus change (%)	+23	+14	+20	+21	--	+5
300% modulus change (%)	+4	+0.6	--	--	--	--
Tensile Strength change (%)	-14	-17	+0.8	-5	-2	-2
EB change (%)	-8	-15	-6	-14	-9	0
Change in Properties after ageing in IRM 903 @ 150°C for 72 hours						
Volume swell (%)	+19.60	+17.78	+19.12	+15.72	+15.04	+15.19

Vulcanizate properties are well maintained for all of the different shore A hardness levels. Only a marginal decrease in tensile strength can be noted for the 60 and 70 shore A compounds although, it is still at an acceptable level for most applications. Compound hardness remains virtually unchanged.

Volume swell is improved for both the 60 and 70 shore A compounds. Volume swell for the 80 shore A compound, although not improved due to the very high loading causing lower polymer/filler interaction, is well maintained which, is a positive given the improvement in processing achieved at this often difficult compound hardness.

The Thermax® Advantage

HNBR has become a very popular elastomer for sealing applications that require good resistance to oil and various automotive chemicals at high temperature while maintaining excellent low temperature performance, such as seals, gaskets and hose. Thermax® N990, thermal carbon black is an excellent filler choice for these compounds. Thermax® N990 allows for a higher proportion of carbon black to be loaded into the compound without degrading the natural performance and characteristics of the compound.

Thermax®, due to the unique characteristics of low structure combined with a large particle size, adds an extra degree of security by promoting lower heat development during processing which reduces the risk of scorch. This reduced risk benefit is especially important in high hardness compounds of more than 80 Shore A.

Thermax® N990 thermal carbon black from Cancarb Limited, can improve compound processing, and allow the desirable dynamic properties of the HNBR polymer to be fully realized while potentially reducing the compound cost by both drastically lowering the scrap rate due to scorch, and allowing for higher filler loading. The ability to produce the required volume of compound with the desired properties while using less of the expensive polymer and more of the inexpensive filler translates directly into cost savings and a stronger bottom line.

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