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TECHNICAL BULLETIN

N990 Medium Thermal Carbon Black in NBR/PVC Rubber

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.

Thermal black is non-reinforcing and is often blended with furnace carbon blacks and/or mineral fillers to achieve cost reduction and specific physical properties in a rubber compound. When used in an NBR/PVC compound, improved compression set properties can be realized, greatly benefiting applications that require good sealing properties.

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 NBR/PVC 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
*NBR/PVC (70:30)	100	100	100	100	100	100
MC Sulphur	1.5	1.5	1.5	1.5	1.5	1.5
Stearic acid	1.5	1.5	1.5	1.5	1.5	1.5
Zinc Oxide	5	5	5	5	5	5
FEF N550	40	--	60	30	80	40
Thermax N990	--	90	--	70	--	90
DOP	25	25	25	25	25	25
TDQ	1	1	1	1	1	1
CBS	1.5	1.5	1.5	1.5	1.5	1.5
TMT	0.2	0.2	0.2	0.2	0.2	0.2

*NBR/PVC(70:30) is Chemigum NVC 573 from ELIOKEM

1702 Brier Park Crescent N.W., Medicine Hat, AB, Canada, T1C 1T9 Phone 1.403.527.1121 Fax 1.403.529.6093 customer_service@cancarb.com www.cancarb.com

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Test Compound Properties

Compound	A1	A2	B1	B2	C1	C2
Viscosity M_L (1+4) @ 100° C	27	28	44	44	61	61
Mooney Scorch Time t_5 @ 125° C (min)	4.1	3.3	3.6	3.4	3.3	3.1
Rheometric properties @ 160° C						
M_L (lbf.inch)	3.84	4.48	6.15	5.94	7.99	6.87
M_H (lbf.inch)	44.94	47.54	58.29	58.98	63.16	67.35
t_S2 (min)	1.54	1.27	1.39	1.28	1.26	1.19
t90(min)	24.51	21.03	23.54	28.62	30.13	32.75
Vulcanizate properties						
Curing at 160°C for t90 minutes according to Rheometer						
Hardness (Shore A)	62	63	72	73	81	82
100% modulus (Kg/cm^2)	36	33	48	52	68	70
200% modulus (Kg/cm^2)	70	66	112	116	142	144
300% modulus (Kg/cm^2)	117	99	--	--	--	--
Tensile Strength (Kg/cm^2)	191	140	170	154	164	167
Elongation @ Break (%)	520	530	320	280	250	250
Tear Strength (Kg/cm)	42	44	45	46	38	39
Compression Set % (ASTM Method B, 70 hrs / 70°C / 25% deflection)	59	62	52	48	50	47

For each of the respective hardnesses, compound viscosity is maintained even at the higher loadings of Thermax® N990. Also, at comparatively higher loadings, Thermax® does not adversely affect Mooney scorch or curing behaviour.

Improvement in compression set resistance is noticeable for the compounds using Thermax® N990, except for the 60 Shore A hardness compound. This improvement is very beneficial for applications that require good sealing properties such as; seals, gaskets and hoses (for better clamp-fitting), which are the main applications of NBR/PVC.

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Compound	A1	A2	B1	B2	C1	C2
Change in physical properties after air ageing @ 100° C for 70 hours						
Hardness change (points)	+ 7	+ 8	+ 7	+ 9	+ 5	+ 5
100% modulus change (%)	+ 6	+ 15	+ 15	+ 31	+ 28	+ 47
200% modulus change (%)	+ 33	+ 34	+ 34	+ 35	--	--
300% modulus change (%)	+ 29	+ 30	--	--	--	--
Tensile Strength change (%)	-4	-4	+ 4	+ 2	NIL	+ 4
EB change (%)	-27	-28	-22	-23	-28	-28
Change in Properties after ageing in IRM 903 @ 100°C for 70 hours						
Volume swell (%)	-12	-11	-10	-8	-9	-8
Hardness change, points	+ 13	+ 13	+ 12	+ 12	+ 10	+ 10
100% modulus change (%)	+ 56	+ 55	+ 68	+ 62	+ 81	+ 69
200% modulus change (%)	+ 80	+ 76	--	--	--	--
300% modulus change (%)	+ 54	+ 41	--	--	--	--
Tensile Strength change (%)	-1	NIL	+ 6	+ 5	+ 4	NIL
EB change (%)	-35	-34	-31	-31	-36	-36
Change in Properties after ageing in Fuel B @ 23°C for 48 hours						
Volume swell (%)	+ 4	+ 4	+ 11	+ 11	+ 9	+ 8
Hardness change (points)	-5	-4	-6	-5	-11	-10
100% modulus change (%)	-25	-20	-27	-26	-24	-22
200% modulus change (%)	-15	-15	-19	-18	-15	-16
300% modulus change (%)	-18	-18	--	--	--	--
Tensile Strength change (%)	-35	-27	-31	-26	-25	-25
EB change (%)	-23	-19	-22	-18	-16	-12

Stress-strain properties after aging in air, oil and fuel B, are maintained with the one exception of the original tensile strength of the 60 Shore A compound which is slightly lower when Thermax® N990 is used without blending with FEF N550 black. Compound hardness remains virtually unchanged.

The Thermax® Advantage

NBR/PVC is a very popular elastomer for sealing applications that require good oil & fuel resistance combined with excellent weathering resistance, 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 is especially important in high hardness compounds of more than 80 Shore A.

Thermax® N990 thermal carbon black from Cancarb Limited, can reduce production cost by allowing the desirable properties of the polymer to be fully realized while reducing the risk of scrap due to scorch.