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TECHNICAL BULLETIN

N990 Medium Thermal Carbon Black in Polychloroprene 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 in all polymers and is commonly used in 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. Polychloroprene is strain crystallizing and similar to natural rubber in chemical structure and tensile strength. This similarity to natural rubber extends to the processing and vulcanization properties of polychloroprene as far as the effect of carbon black is concerned. Thermax® can be loaded in polychloroprene vulcanizates in greater amounts than reinforcing fillers for a given hardness while still retaining the good tensile properties. This high loading ability translates directly to cost savings for the compound.

The following study, conducted on behalf of Cancarb Limited by the Indian Rubber Manufacturers Research Association, Thane, India, shows the effect of replacing FEF black N550 with Thermax® N990 in the following CR compounds of three different shore A hardnesses (50, 60 and 70).

CR Test Compound Properties

Formulation (phr)	Hardness 50 SH		Hardness 60 SH		Hardness 70 SH	
	A1	A2	B1	B2	C1	C2
CR - Skyprene B-30	100	100	100	100	100	100
MgO	4	4	4	4	4	4
Thermax® N990	-	40	-	20	-	40
FEF N550	20	-	40	30	60	40
Stearic Acid	1	1	1	1	1	1
Aromatic Oil	15	15	15	15	15	15
ZnO	5	5	5	5	5	5
NA 22	0.5	0.5	0.5	0.5	0.5	0.5
Antioxidant TDQ	1	1	1	1	1	1
TOTAL	**146.5**	**166.5**	**166.5**	**171.5**	**186.5**	**206.5**

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CR Test Compound Properties

Compound	A1	A2	B1	B2	C1	C2
Viscosity M_L (1+4) @ 100° C (MU)	19.0	24.0	38.5	38.0	60.0	58.0
Mooney Scorch Time t5 @ 125° C (min)	6.00	5.10	4.70	4.80	4.00	3.90
Rheometric properties @ 160° C						
M_L (lbf.inch)	3.80	4.14	5.60	5.45	8.44	8.33
M_H (lbf.inch)	51.00	55.60	66.60	66.55	78.10	79.16
tS2(min)	2.00	1.91	1.64	1.66	1.52	1.53
t90(min)	20.00	17.60	30.90	25.50	35.85	34.56
Vulcanizate properties						
Hardness - On Button (Shore A)	48	50	59	60	69	69
300% modulus (Kg/cm^2)	25	52	144	145	n/a	n/a
Tensile Strength (Kg/cm^2)	150	162	186	187	183	176
EB %	615	550	365	360	255	250
Tear Strength (Kg/cm)	23	26	35	35	39	33
Compression Set % (ASTM D 395, Method B, 22 hrs/100°C/25% deflection)	11	14	10	11	8	9
% Change in physical properties after air aging @ 100°C for 70 hours.						
Hardness Change (points)	+1	+1	+3	+2	+2	+3
300% Modulus (change)	+16	+27	+10.5	+16.5	n/a	n/a
Tensile Strength (change)	+2	-0/5	-0.5	Nil	+1	+1
EB (change)	-7	-7	-8	-7	-10	-8
% Change in physical properties after aging @ 100° C for 70 hours in ASTM oil No.1						
Volume Swell (70hrs/100°C)	+3.6	+3.8	+2.6	+2.7	+2.5	+2.1

After complete replacement of the N550 FEF black with Thermax® N990, the 50 Shore A hardness compound maintained excellent tensile and tear strength. Volume Swell in ASTM oil #1, compression set and air aging properties all remain at satisfactory levels. However, a slight increase in compound viscosity and small drop in elongation at break are observed.

In the higher hardness compounds, 60 and 70 Shore A, the FEF N550 black was replaced by Thermax® N990 in a 1:2 proportion without any significant change in both the vulcanized and un-vulcanized properties.

The Thermax® Advantage

With the persistent availability problems and increasing cost of polychloroprene polymer, maintaining compound cost while preserving the desired properties is a major problem. Thermax® N990, thermal carbon black is an excellent solution to this problem. Thermax® N990 allows for a higher proportion of carbon black to be loaded into the compound which produces a higher volume of compound without consuming more of the expensive polymer. The achievable cost savings will depend upon the specific recipe in use and the local raw material costs.

Further reduction in compound cost can be realized with some loss of stress-strain properties by replacing the FEF black with Thermax® MT black in even higher proportions.

In the highly competitive global polychloroprene rubber market, Thermax® MT carbon black is the ideal filler for achieving both cost reduction and excellent dynamic properties.