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TECHNICAL BULLETIN

Fluoroelastomer Compounds

Thermax® N990 medium thermal carbon black 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 dispersion, superior heat, oil and chemical resistance and demanding dynamic properties. The large particle size (low surface area) and low structure allow for low compression set, high rebound and low viscosity maintaining the inherent elastomeric properties of the rubber compound. As a non-reinforcing black, thermal carbon black is often used to achieve cost reduction and specific physical properties in the rubber compound.

Thermax® N990 can be used in all polymers and is commonly used in elastomers such as NBR, EPDM, HNBR, ACM, FKM and ECO. High loadings of Thermax® are possible, while maintaining low viscosity and physical properties such as low compression set, thereby allowing manufacturers to reduce compound cost.

Medium thermal carbon black is the most widely used filler in fluorocarbon (FKM) rubber. FKM compounds utilizing N990 exhibit a better balance of processing and performance properties than other commercially available carbon blacks. These favourable properties are also more stable at different loadings and durometer levels than other carbon blacks. Thermax® N990 is a cost effective filler to use in FKM, particularly at higher loadings.

This technical bulletin provides basic data on the use of Cancarb's Thermax® N990 at two loadings, 30 phr and 60 phr, in a high grade FKM rubber compound. The FKM recipe used is reported in Table 1:

Table 1: Compound Test Formulation

	Thermax® N990 – 30 phr	Thermax® N990 – 60 phr
Dyneon FE-5642	100.00	100.00
Maglite DE	3.00	3.00
Calcium Hydroxide HP	6.00	6.00
Carnauba Wax	1.00	1.00
TOTAL phr	**140.00**	**170.00**

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The base polymer, FE-5642 is a product of 3M-Dyneon and is an "A" or 66% fluorine type with an incorporated bis-phenol cure system. The polymer is typically used in molded goods and rubber-to-metal bonding applications.

The compounds were mixed in a cooled Farrel BR Banbury, sheeted on a 13" laboratory mill and air cooled. An upside down mixing procedure was used for both compounds. The process was repeated 24 hours later to insure thorough dispersion. Each compound was two-pass mixed.

Processing test data includes Mooney Viscosity at 121°C, ODR at 150°C and MDR at 204°C. The physical property tests were taken on both press cured 3 x 6 sheets, cured ten minutes at 177°C, on sheets press-cured at the same conditions and oven post-cured 16 hours @ 232°C. The processing data is provided in Table 2 below.

Table 2: Compound Data

	N990 – 30 phr	N990 – 60 phr
Mooney Viscosity ML @ 121°C (1 + 10)		
MI, pts	124	154
10 minutes	74	110
Rheological Measurements, ODR @ 177°C		
MH, pts	100	116
MH-ML, pts	85	95
MI, pts	15	18
ML, pts	15	21
Tc50, minutes	5.4	6.1
Tc90, minutes	7.4	9.3
Ts2, minutes	2.8	2.6
CRI	21.5	14.9
MDR @ 204°C		
MH, pts	16.0	19.6
MH-ML, pts	13.6	15.6
MI, pts	6.2	8.1
ML, pts	2.5	4.1
Tc50, minutes	1.3	1.6
Tc90, minutes	2.0	2.9
Ts2, minutes	1.0	0.9
CRI	96.2	49.5

Physical Properties

	N990 – 30 phr	N990 – 60 phr
Press Cured 10 minutes @ 177°C, no post-cure		
Shore A Hardness	70	85
Specific Gravity	1.832	1.837
Modulus @ 25%, MPa	1.53	3.33
Modulus @ 50%, MPa	2.17	4.74
Modulus @ 100%, MPa	3.82	7.42
Modulus @ 200%, MPa	7.90	9.70
Elongation at Break (%)	318	279
Tensile Strength, MPa	10.5	10.2
Press Cured 10 minutes @ 177°C, oven post-cured 16 hours @ 232°C		
Shore A Hardness	75	90
Specific Gravity	1.85	1.853
Modulus @ 25%, MPa	1.68	4.73
Modulus @ 50%, MPa	2.55	6.79
Modulus @ 100%, MPa	5.57	12.31
Modulus @ 200%, MPa	16.41	-
Elongation at Break (%)	203	144
Tensile Strength, MPa	16.71	17.37

It is evident from the rheological and physical property data that the difference in properties arising from the additional 30 phr is minimal, reflecting the inert and non-reinforcing attributes of the large particle, low structure medium thermal carbon black.

Bis-phenol cure systems used in fluorocarbon polymers are sensitive to the pH of the ingredients. Additions of materials with lower pH or acidic additives will slow the cure. Higher pH or basic materials will accelerate the cure. Cancarb's Thermax® N990 has a pH specification of 9 – 11. For applications and molding conditions where an acidic pH is preferable, Cancarb's Thermax® N990 Ultra Pure has a typical pH in the range of 4 – 6.