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TECHNICAL BULLETIN

Natural Rubber Engine Mounts II

Thermax® medium thermal carbon black is characterized by its large particle size and low level of particle agglomeration. Thermax® is widely used in anti-vibration applications such as engine mounts, which require excellent dynamic properties. The large particle size (low surface area) and low structure allow for high rebound, low tan delta and low hysteresis, thereby maintaining the inherent elastomeric properties of the rubber compound.

The typical properties of Thermax® N990 are as follows:

	Thermax® N990
NSA m^2/g	9.7
DBP cc/100 g	38
PH	10
Ash content %	0.1
325 Mesh Sieve Residue, ppm	8
Fines %	4
Pellet Crush, g, 10 mesh	20

In this report, the use of Thermax® N990 in an engine mount compound is demonstrated. As a non-reinforcing carbon black, Thermax® is typically blended with an FEF, GPF or SRF furnace black. The following data shows an engine mount compound based on natural rubber and formulated for the low hardness and modulus typical of such a compound. An EV curing system was used to prevent reversion and provide good heat resistance.

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Formulation/Properties

Compound #	1	2	3
SMR 5	100.0	100.0	100.0
Thermax® N990	45.0	70.0	95.0
N762 SRF Black	15.0	15.0	15.0
Sundex 790 Aromatic Oil	15.0	15.0	15.0
Zinc oxide	3.0	3.0	3.0
Stearic Acid	1.0	1.0	1.0
Vulkanox HS/LG Antioxidant	1.0	1.0	1.0
Vulkacit Thiuram Accelerator	0.5	0.5	0.5
Sulphur	0.5	0.5	0.5
TOTAL	**181.0**	**206.0**	**231.0**
Specific Gravity	1.16	1.22	1.26
Compound Properties			
Mooney Viscosity			
(ML 1 + 4 @ 100°C)	19.2	29.6	37.4
Mooney Scorch @ 121°C			
T5, min.	30.0	-	-
T35, min.	30.0	-	-
Monsanto Rheometer @ 160°C, 1° arc, 50 range, 1.7 Hz.			
ML	3.41	3.87	4.51
MH	26.81	29.71	33.49
Ts1, min.	3.60	3.26	2.57
Ts2, min.	3.86	3.49	2.77
T50, min.	4.55	4.13	3.39
T90, min.	5.72	5.29	4.59
Vulcanizate Properties			
Cure time @ 160°C	11	10	10
50% Modulus, MPa	0.78	0.9	1.1
100% Modulus, MPa	1.3	1.6	2.2
200% Modulus, MPa	3.3	4.2	5.6
300% Modulus, MPa	6.3	8.2	9.3
400% Modulus, MPa	10.9	13.3	12.8
Tensile Strength, MPa	20.6	17.8	16.0
Elongation %	535	480	470
Shore A Hardness	43	49	56

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Formulation/Properties

Compound #	1	2	3
Compression set, %, 70H @ 100°C, cured t90 + 10 minutes	42	41	42
DeMattia Crack Growth			
Kc to 300% crack growth	78	21	9
Kc to 600% crack growth	225	53	22
Thermax® N990	45	70	95
N762 Carbon Black	15	15	15
Dynamic Properties, MER 1100 @ 20 Hz			
Tan delta			
@ 0°C	0.057	0.151	0.16
@ 25°C	0.084	0.027	0.052
@ 100°C	0.046	0.064	0.088
E*			
@ 0°C	2.872	5.008	6.991
@ 25°C	3.114	3.973	5.490
@ 100°C	2.93	3.803	5.158
E′			
@ 0°C	2.867	4.962	6.903
@ 25°C	3.103	3.972	5.483
@ 100°C	2.931	3.795	5.138
E″			
@ 0°C	0.163	0.748	1.105
@ 25°C	0.261	0.107	0.285
@ 100°C	0.135	0.243	0.452
Dynamic/Static Stiffness Ratio @ RT			
Dynamic Stiffness kg/mm	2.395	3.056	4.223
Static Stiffness kg/mm	5.305	4.991	4.979
Dynamic/Static Stiffness Ratio	0.451	0.612	0.848

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Discussion

The above results are typical of those seen with N990 loaded as a filler. As a non-reinforcing filler, compounds with Thermax® will typically have lower viscosity and excellent processing conditions. Thermal black will provide lower hardness than reinforcing carbon blacks, as can be seen in the above compounds, including the highly loaded #3. Modulus is low and the loss in tensile strength with the higher loadings is minimal.

For superior dynamic properties in engine mounts, it is desirable to have the lowest possible values for dynamic stiffness, tan delta and transmissibility. The test results indicate that Thermax® N990 can provide excellent dynamic properties, in all respects. Thermax® has the least tendency to affect the inherent elastomeric properties of rubber compounds and hence its widespread use in applications such as anti-vibration parts, engine and muffler mounts, rail and bridge pads.

Cancarb recommends the above compound #1 as a starting formulation for a natural rubber engine mount. This compound has the lowest stiffness as shown by E′ and E″ and the dynamic/static stiffness ratio. It also has superior cut growth properties.